Indoor Air Quality & Healthcare

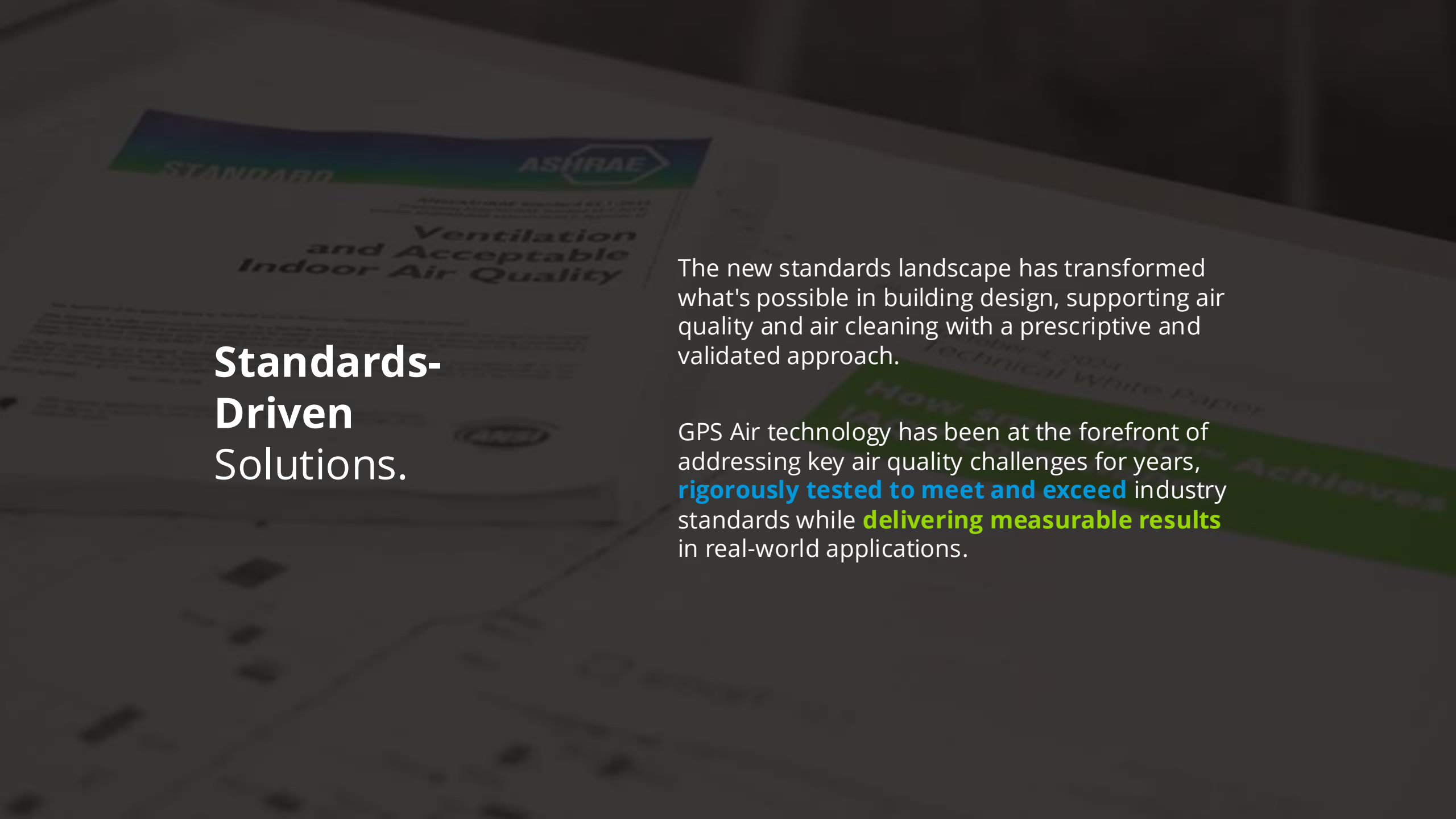
HVAC Efficiency, Managing
V.O.C.'s, and Infectious Aerosols

Audwin Cash
CEO, GPS Air
May 2025

Air Quality **Where It Matters.**

Harmful indoor air contaminants can come from many sources, including **outside air, occupants** within the space, as well as the **buildings** and furnishings themselves.

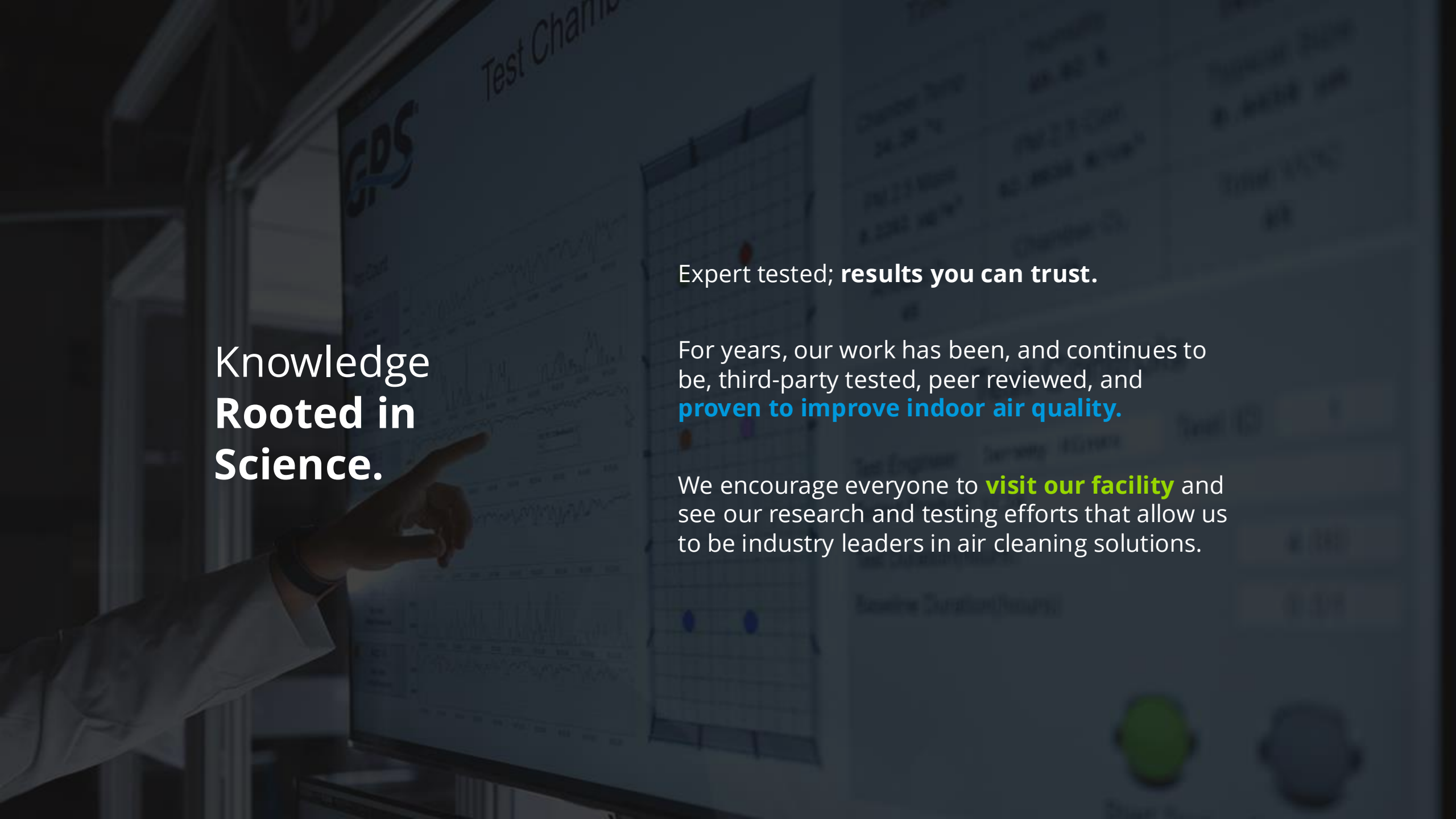
Our technology **tackles the pollution, pathogens, and odors** produced by these sources, protecting the air we breathe.



Standards-Driven Solutions.

The new standards landscape has transformed what's possible in building design, supporting air quality and air cleaning with a prescriptive and validated approach.

GPS Air technology has been at the forefront of addressing key air quality challenges for years, **rigorously tested to meet and exceed** industry standards while **delivering measurable results** in real-world applications.



Knowledge **Rooted in Science.**

Expert tested; **results you can trust.**

For years, our work has been, and continues to be, third-party tested, peer reviewed, and **proven to improve indoor air quality.**

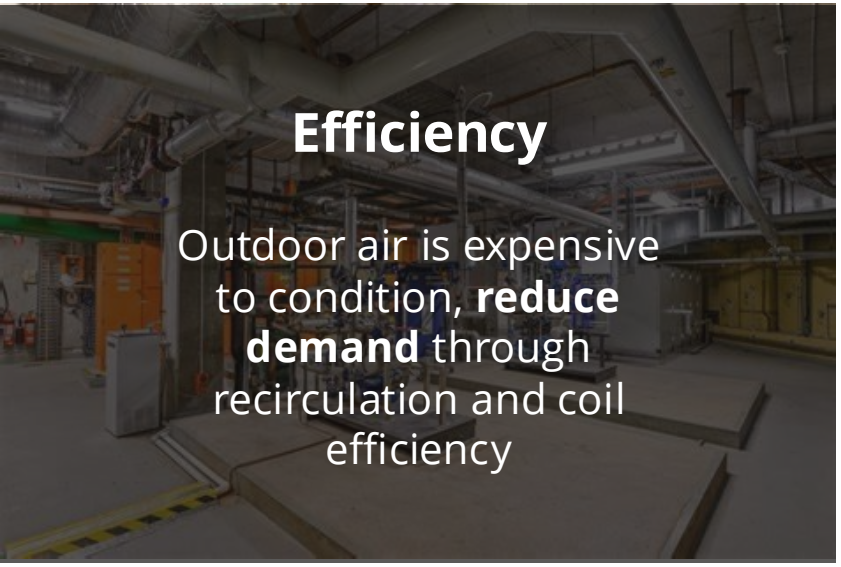
We encourage everyone to **visit our facility** and see our research and testing efforts that allow us to be industry leaders in air cleaning solutions.

Air quality problems indicate Inadequate Clean Air Delivery

- Laboratory & treatment areas operating over design capacity
- Space use evolves for community & technology/equipment needs
- New procedures and testing protocols increase VOCs
- Outdoor air is not adequately clean, wildfires, pollution, vehicle exhaust

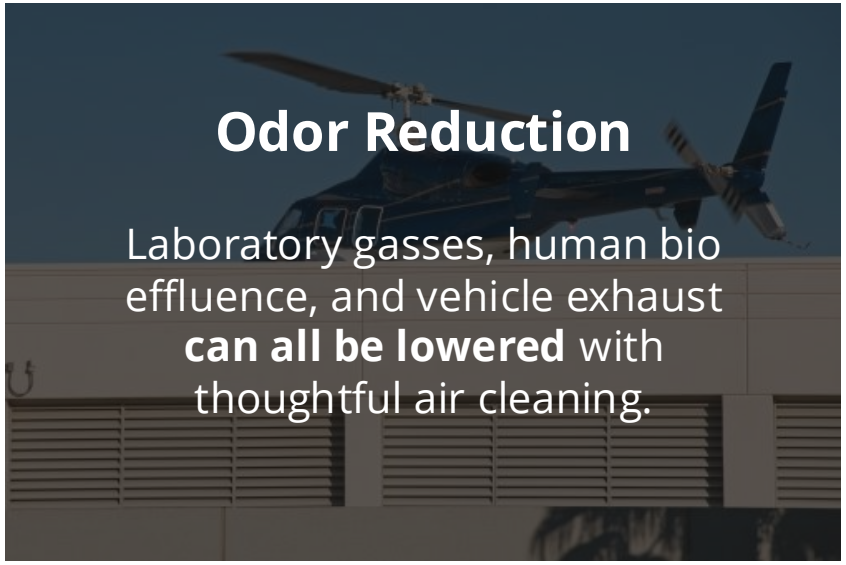
Better air through Air Cleaning

Air Quality Solutions for Healthcare
Efficiency, Odor Reduction, Lowering Infectious Aerosols.



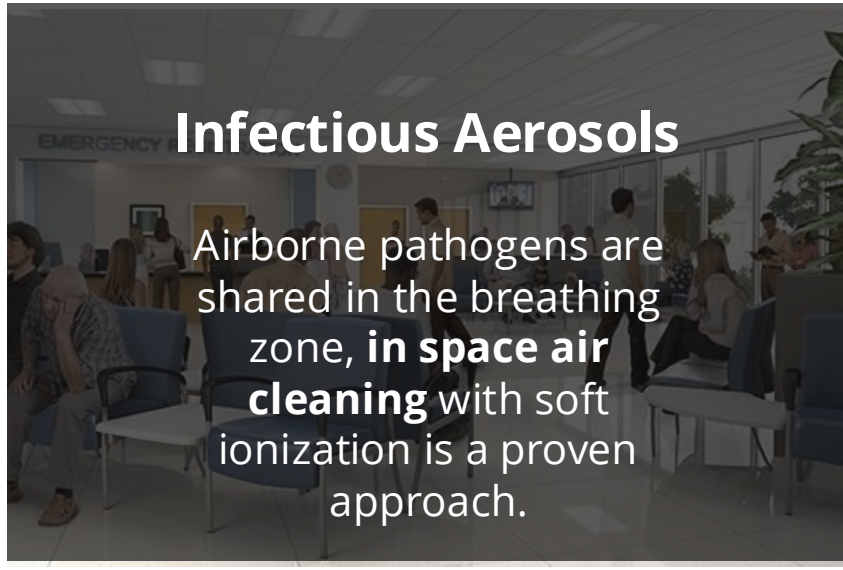
Efficiency

Outdoor air is expensive to condition, **reduce demand** through recirculation and coil efficiency



Odor Reduction

Laboratory gasses, human bio effluence, and vehicle exhaust **can all be lowered** with thoughtful air cleaning.



Infectious Aerosols

Airborne pathogens are shared in the breathing zone, **in space air cleaning** with soft ionization is a proven approach.


Global Plastic Solutions

GPS® Solutions:
Specialized Solutions

Maintenance Free

Low Power

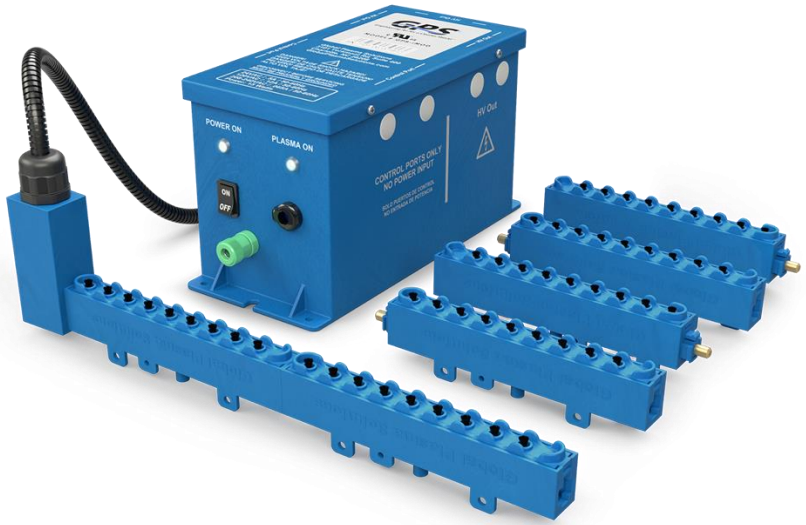
Quiet Operation

UL 2998

Standard 241 Appendix A Safety
Ozone, Formaldehyde, PM2.5

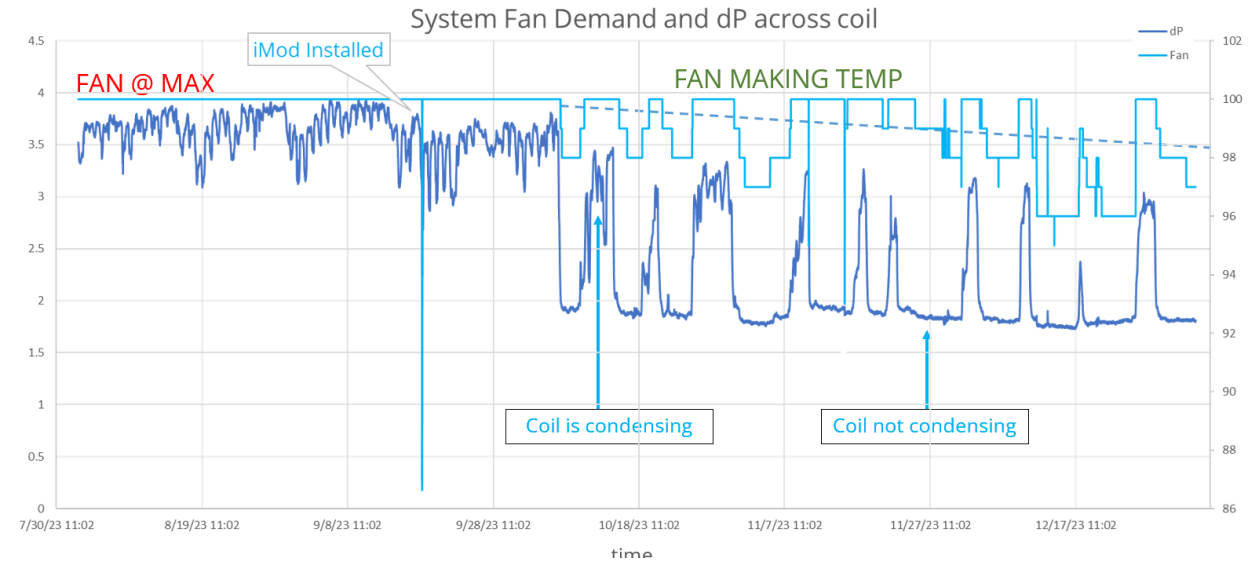
Effective on Pathogens, Odors, & Particles
Third party SARS-CoV-2 results
with Standard 241 protocol

Integrated NPBI



System Fan Demand with Differential Pressure Data

Taken together, the fan speed began to decline as both the maximum and minimum coil pressure drop began to decline. This indicates a reduction of static pressure due to the coil biofilm being reduced after the iMod was installed.



Keeping Coils Clean **Improves Efficiency** and Lowers Microbiological Risk

GPS Air iMod® provides ongoing coil cleaning, static pressure reduction and requires no replacement parts.

The Clear Advantage

GPS Soft Ionization delivers **superior performance** with **certified safety**, **maintenance-free operation**, and **lower lifetime costs** compared to alternative technologies.

	Safety Certification	Maintenance Free	Initial Costs	Recurring Costs	Supported by Standards
GPS Soft Ionization	**YES**	**YES**	**$$**	**None**	**YES**
UV-C	NO	NO	$$$$	$$$	NO
Hard Ionization	NO	NO	$$$	$$	NO

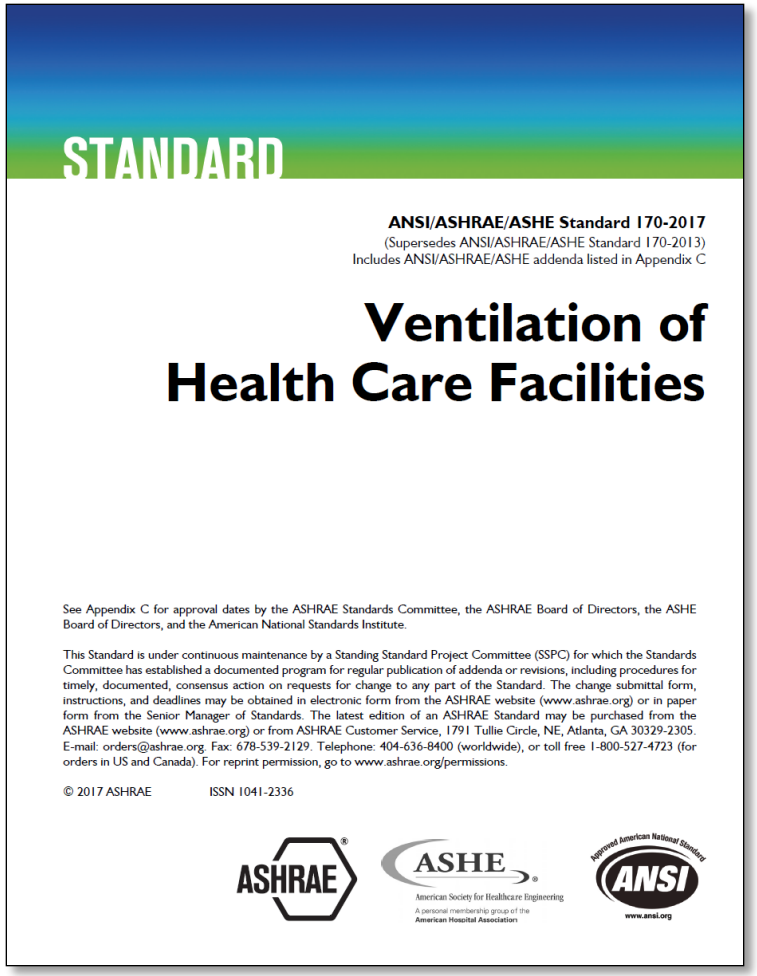
Over 40% of your
HVAC System's Energy
Use is Conditioning
Outdoor Air

Efficiency, Odor, and
Infectious Aerosol
Management options for
ASHRAE 170 and 62.1
Ventilation Designs

Recirculation For Efficiency – Lower Conditioning Demand

q. In a recirculating ventilation system, HEPA filters shall be permitted instead of exhausting the air from these spaces to the outdoor, provided the **return air passes through the HEPA filters before it is introduced into other spaces**.

	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ach	Minimum Total ach	All Room Air Exhausted Directly to Outdoors (j)
Emergency department public waiting area	Negative	2	12	Yes (q)

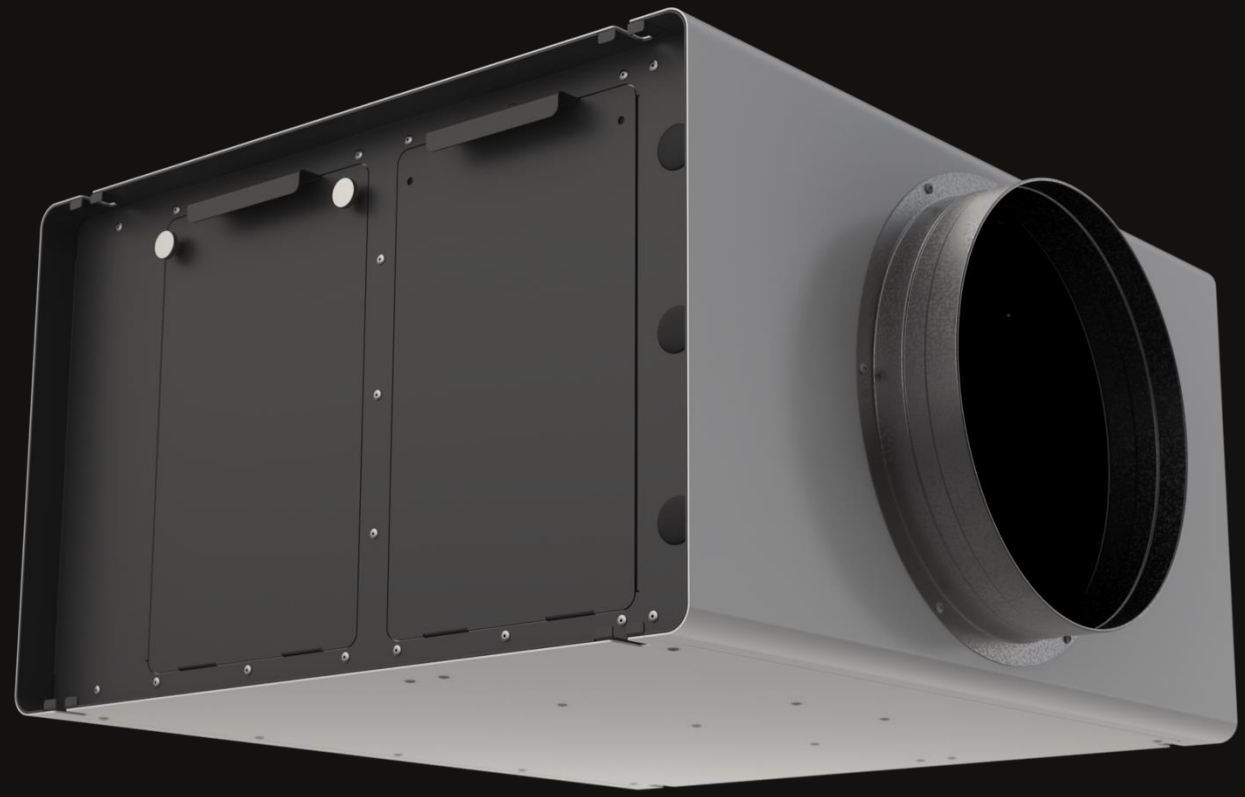


Introducing,

smartIAQ

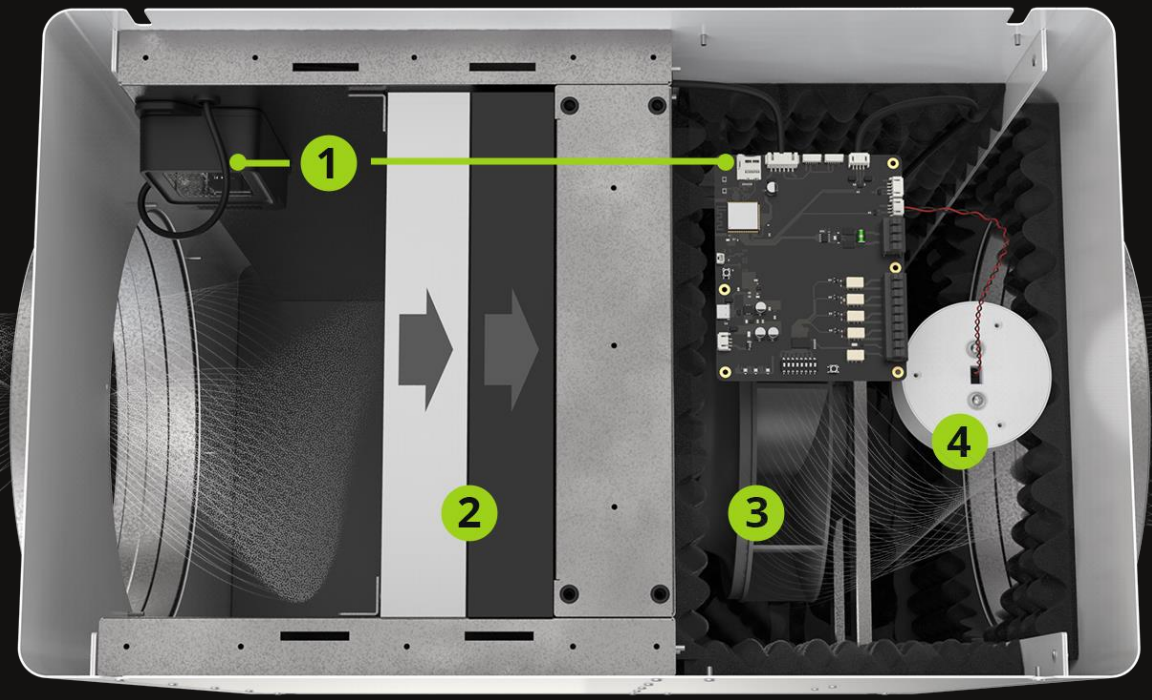
The First Dedicated Clean Air System™

Standards Based On-Demand
Air Cleaning With Real ROI



Designed to Clean Up Your Air.

smartIAQ delivers **quiet, on-demand air cleaning** as needed, actively monitoring and recognizing air quality patterns**.**



1 Advanced solid-state sensors & controller

2 Particle & Carbon Molecular Filters

3 Efficient whisper quiet EC blower

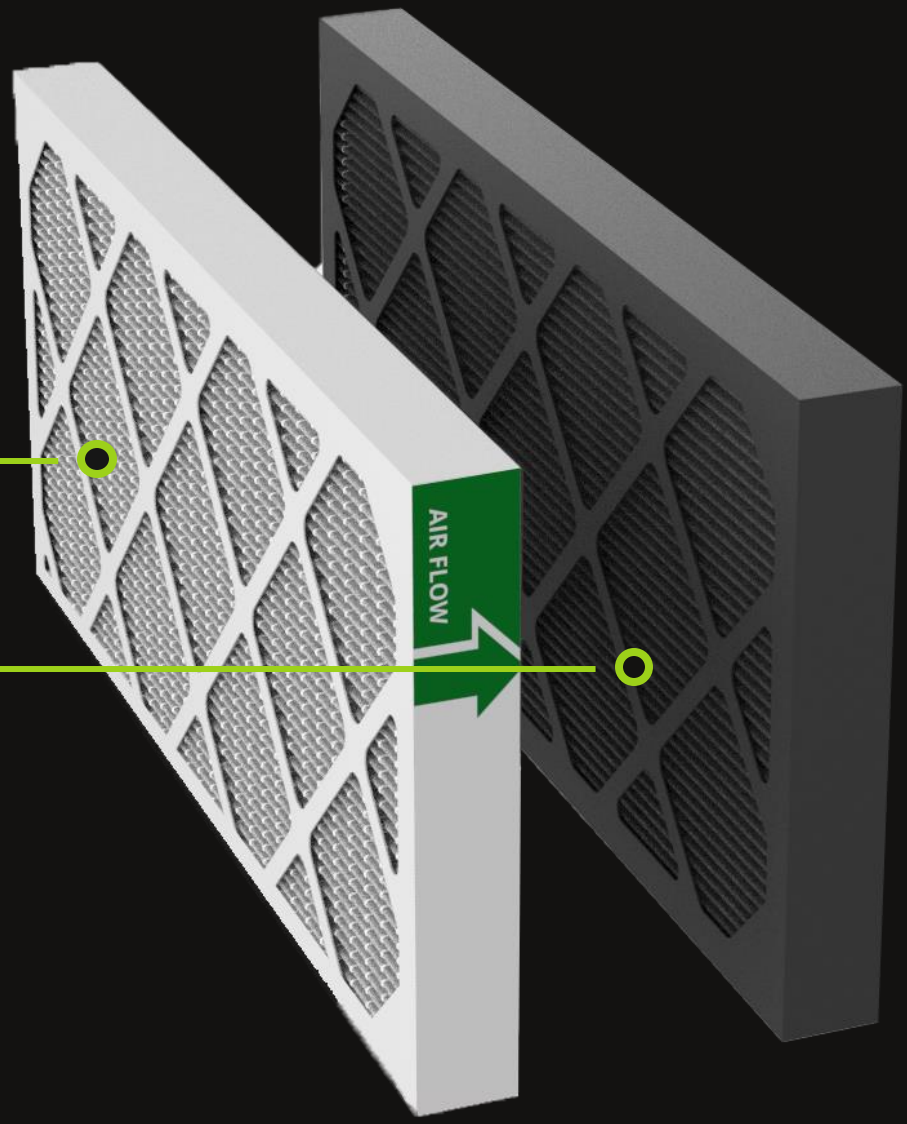
4 Integrated NPBI technology

Capture Contaminants with Long Life Filtration Validated to the Standards.

EN1822 / ISO29463
2” HEPA Particle Filter

ASHRAE 145.2 Tested
2” Molecular Carbon Filter

Standard sizes 12x24x2

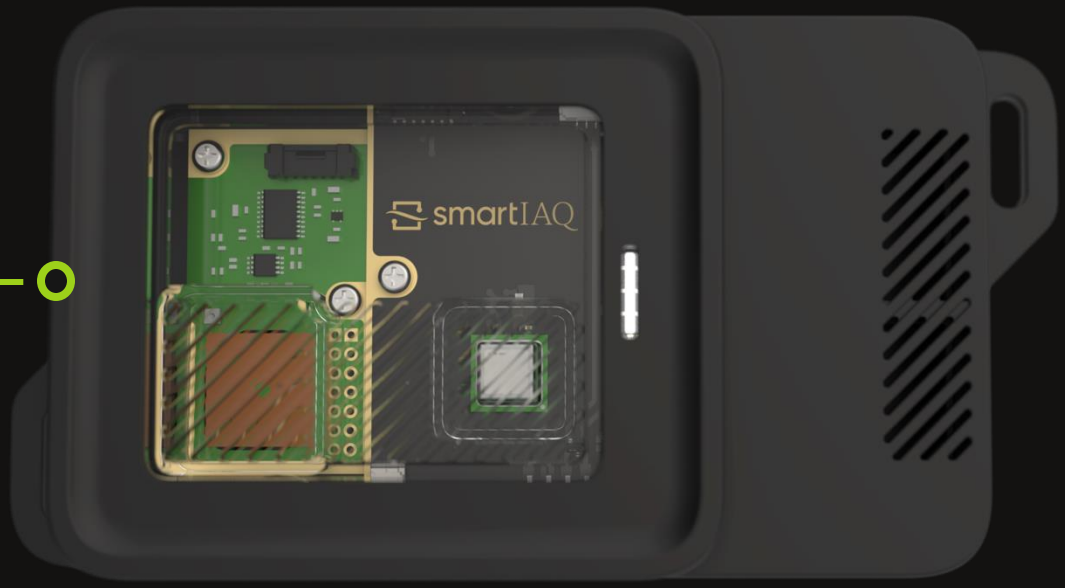


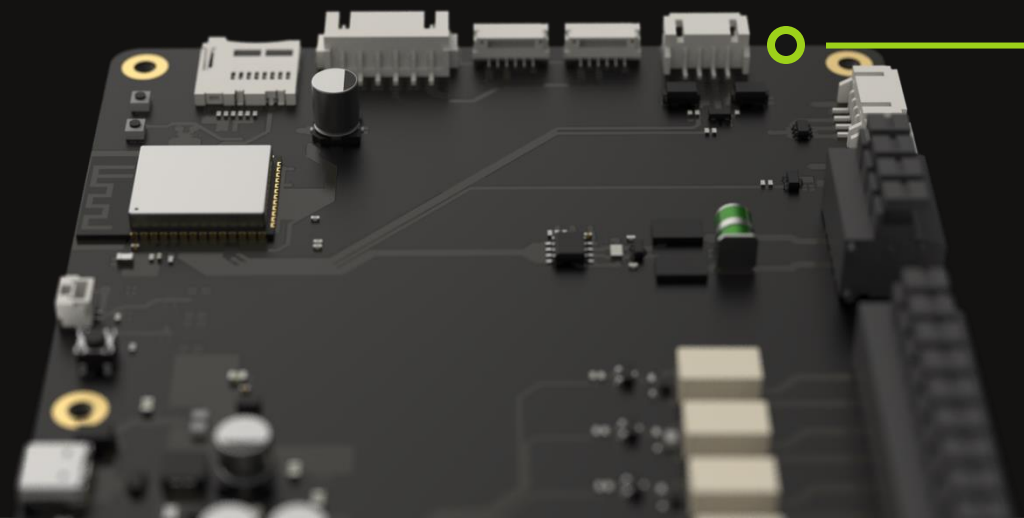
Paired to deliver >1 year filter life

What Makes Our System Intelligent?

Communication between the **advanced solid-state sensors** and **controller** in smartIAQ allows the system to monitor for:

TVOCs, CO_2, Formaldehyde, NO_X, and **Particles** ($PM_{1.0}$, $PM_{2.5}$, $PM_{4.0}$, PM_{10}).





Low Maintenance,
Long Operating Life.

The smartIAQ system is low maintenance with a **10-year operating life** and tool-free access for filter changes.

With an efficient and quiet EC blower, it operates at **whisper quiet** sound levels between NC-25 and NC-35, providing **clean air without disruption.**

Autonomous In-Space Air Cleaning with On-Board Monitoring System.

Contact Closures

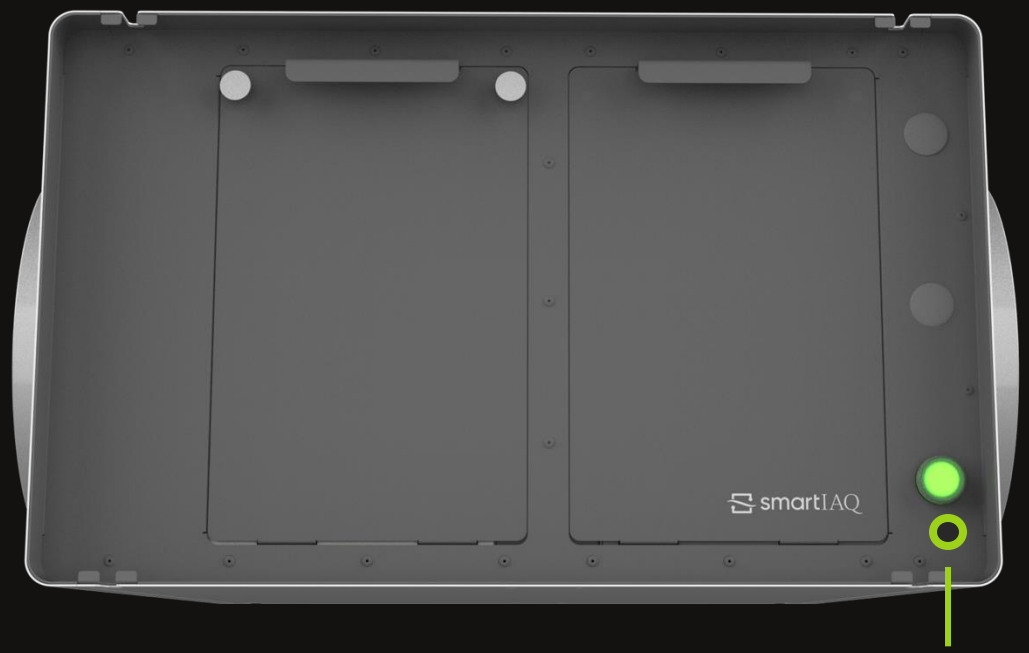
Points of Control: suspend/activate autonomous operation and fire alarm inhibit.

Points of Monitoring: system ready, cleaning cycle active, and service filter/contaminant unmanaged.

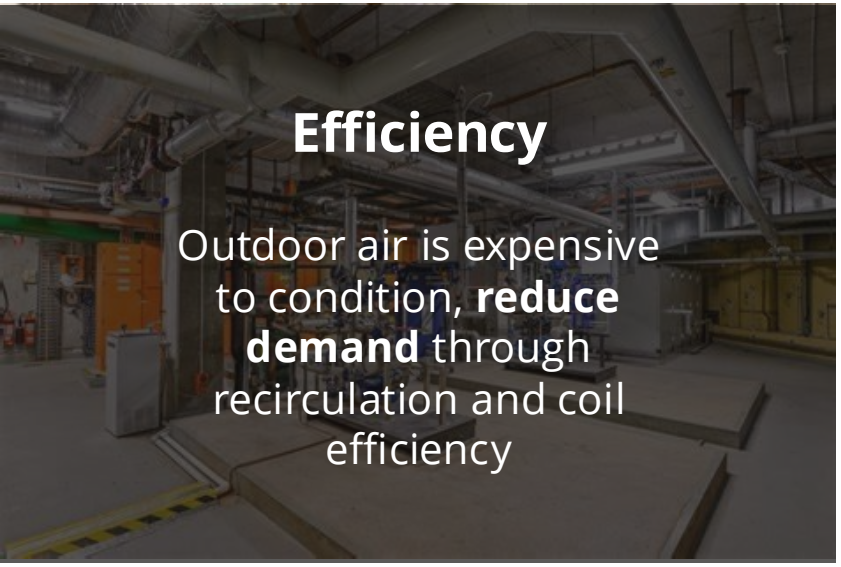
Digital Connectivity (Modbus & BACnet MSTP)

Points of Control: suspend/activate autonomous operation, set fan speed.

Points of Monitoring: all sensor readings (temp, humidity, CO2, TVOC, formaldehyde, NOx, PM levels), fan speed, faults.



Air Quality Solutions for Healthcare
Efficiency, Odor Reduction, Lowering Infectious Aerosols.



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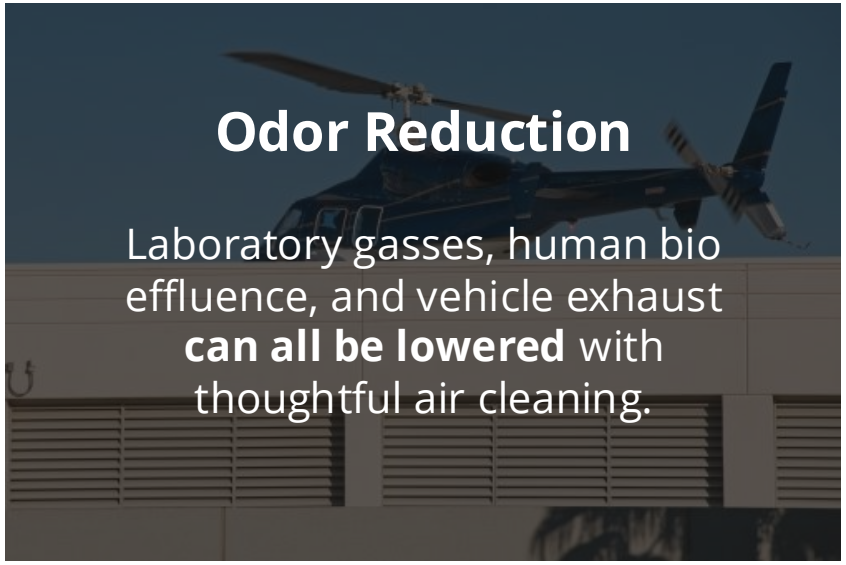

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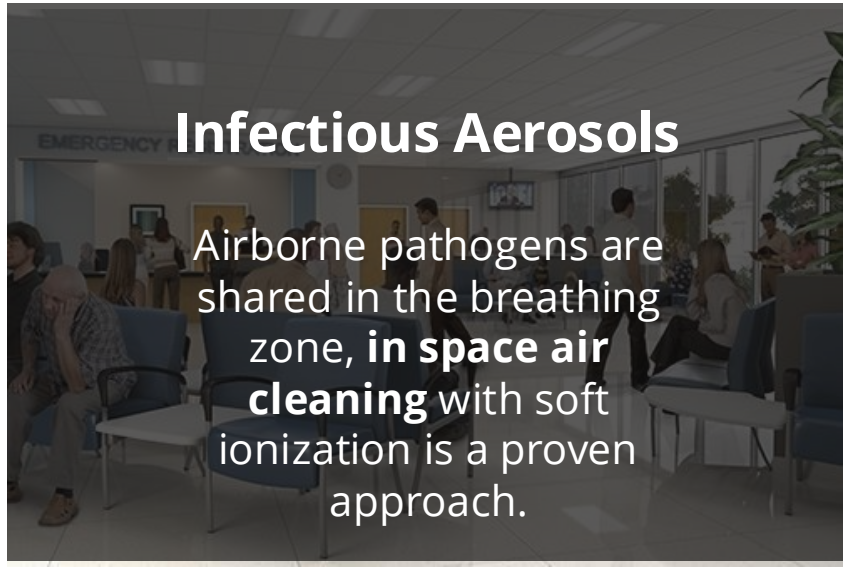

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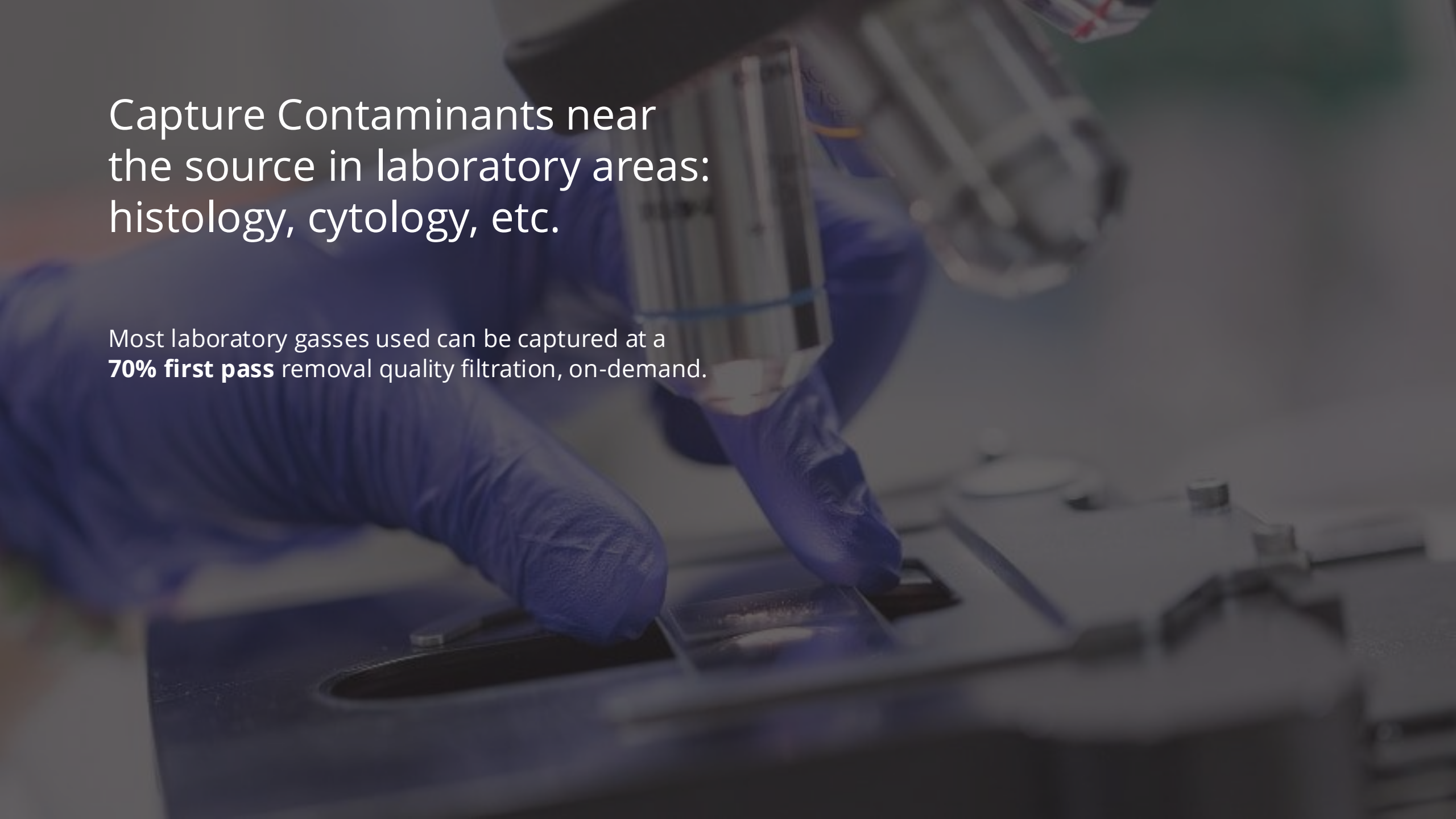

Capture Contaminants near the source in laboratory areas: histology, cytology, etc.

Most laboratory gasses used can be captured at a **70% first pass** removal quality filtration, on-demand.

Active Air Cleaning
Reduces Odors & Improves Reputation

“A team member mentioned that the **air smelled fresher, felt fresher**… the odor had greatly reduced.”

Dan Martin

Plant Engineering Manager, Novant Health

Capture Contaminants with Long Life Filtration Validated to the Standards.

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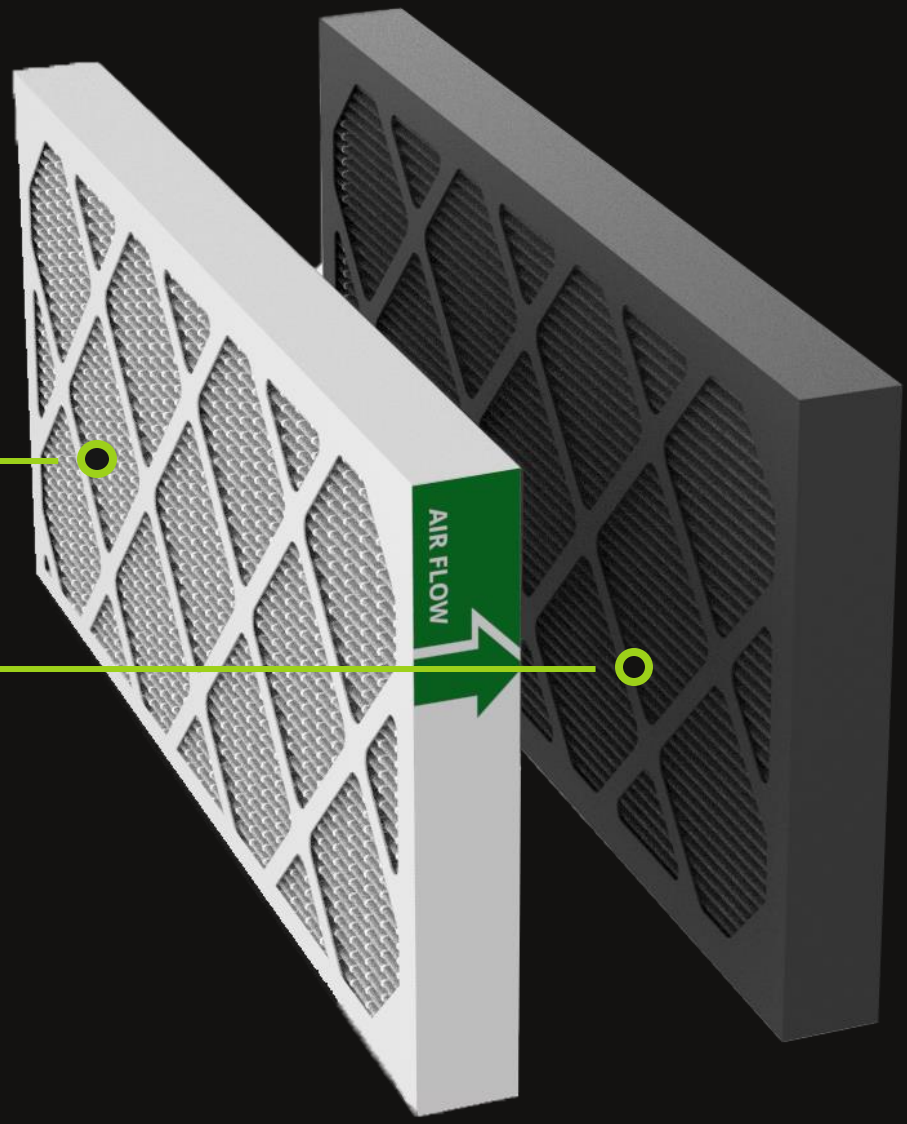

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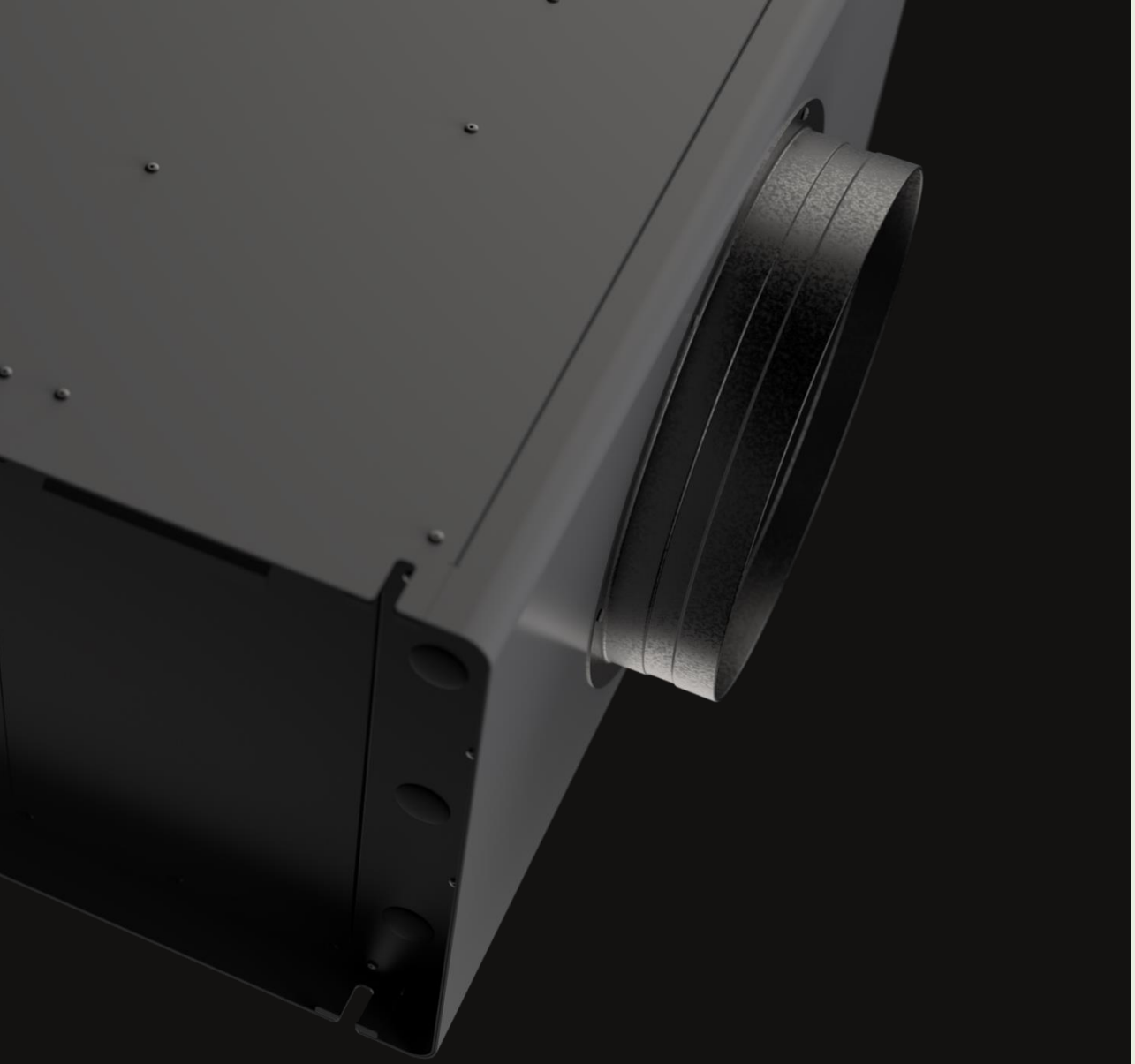

smartIAQ Performance

- Up to 500 cfm of continuous cleaning
- Sensor driven for increased cleaning for contaminant
- UL2998 Zero Ozone
- Standard 241 equivalent clean air rated for 400 to 500cfm
- Integral NPBI

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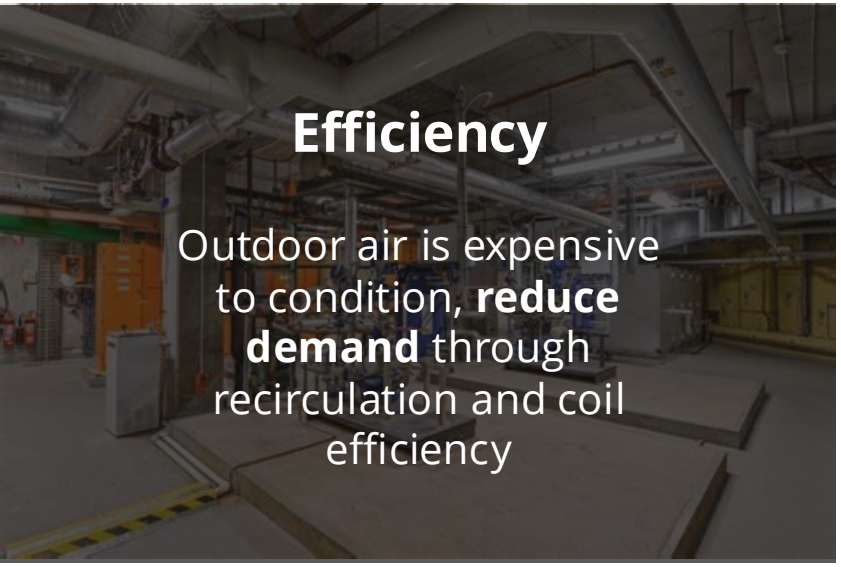
Efficiency, Odor Reduction, Lowering Infectious Aerosols.



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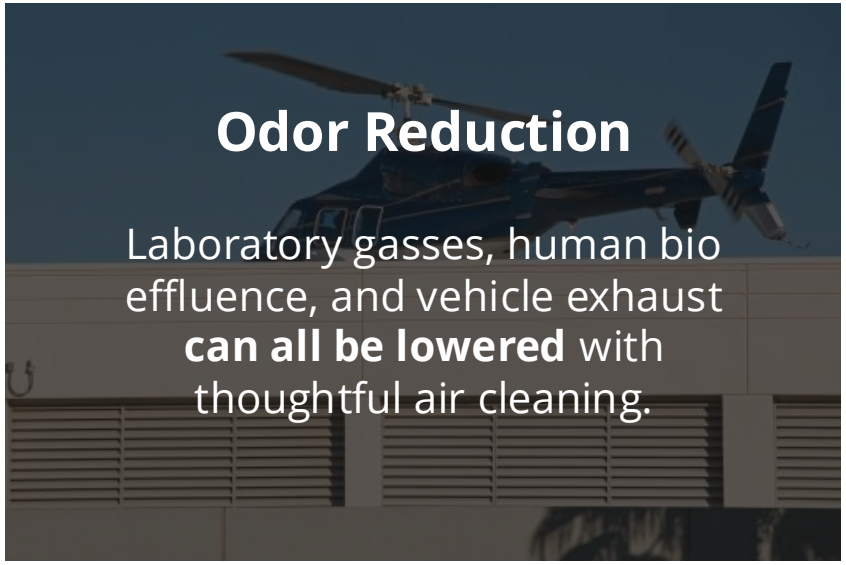

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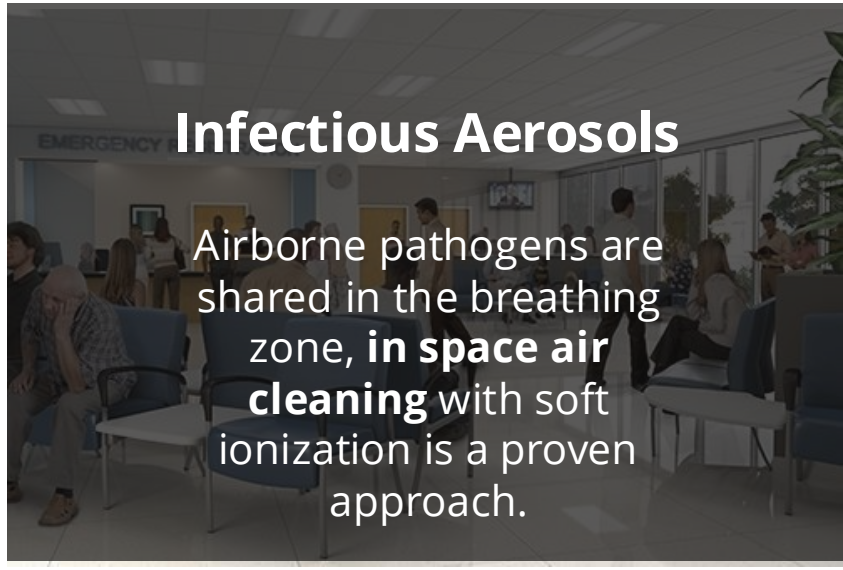

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Your Core Concerns

Safe: Our top priority is to ensure our products strictly comply with safety regulations like UL, ensuring that no harmful byproducts are produced.

Effective: Our products are heavily driven by ASHRAE standards, and our work is proven through Third-Party testing, peer reviews, as well as our own rigorous testing at our facility.

Effective Solutions, **Scientifically Proven** Results

When it comes to your air quality, promises aren't enough. That's why GPS Air products undergo **comprehensive testing by independent, third-party laboratories in realistic conditions.**

Our approach is further supported by **peer-reviewed scientific research** validating the safety and effectiveness of GPS® soft ionization, giving you confidence in real-world performance.

PLOS One

WILEY Online Library

MDPI

IEEE Xplore® Digital Library

INNOVATIVE BIOANALYSIS creating solutions | getting results

assuredbio™

Blue Heaven Technologies

Proven Safe Through Testing Standards

Safety testing beyond industry minimums in ASHRAE **Standard 241 Appendix A**

These specific validation requirements create a clear framework for selecting **safe** air cleaning technologies

ASHRAE Standard 241-2023

Control of Infectious Aerosols

Approved by the ASHRAE Standards Committee on June 24, 2023.

This Standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the Standard. Instructions for how to submit a change can be found on the ASHRAE® website (www.ashrae.org/continuous-maintenance).

The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 180 Technology Parkway, Peachtree Corners, GA 30092. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

 ISSN 1041-2336B

This standard includes links to online supporting files.

Proven Safe Through Testing Standards

Safety testing beyond industry minimums via **Standard 241**

- Particles
- Formaldehyde
- Ozone

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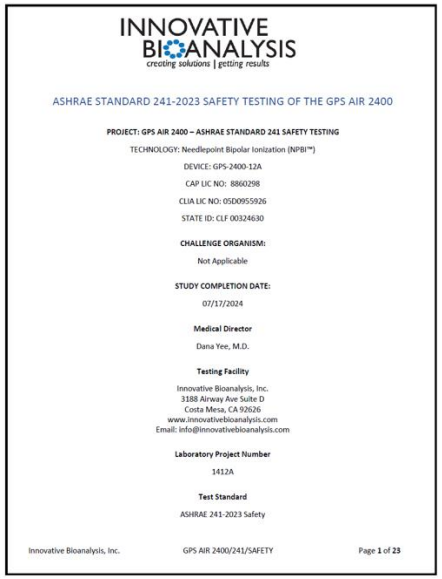


INNOVATIVE BIOANALYSIS
creating solutions | getting results

ASHRAE STANDARD 241-2023 SAFETY TESTING OF THE GPS AIR 2400

PROJECT: GPS AIR 2400 – ASHRAE STANDARD 241 SAFETY TESTING

TECHNOLOGY: Needlepoint Bipolar Ionization (NPBI™)

DEVICE: GPS-2400-12A

CAP LIC NO: 8860298

CLIA LIC NO: 05D0955926

STATE ID: CLF 00324630

CHALLENGE ORGANISM:

Not Applicable

STUDY COMPLETION DATE:

07/17/2024

Medical Director

Dana Yee, M.D.

Testing Facility

Innovative Bioanalysis, Inc.
3188 Airway Ave Suite D
Costa Mesa, CA 92626
www.innovativebioanalysis.com
Email: info@innovativebioanalysis.com

Laboratory Project Number

1412A

Test Standard

ASHRAE 241-2023 Safety

Innovative Bioanalysis, Inc. GPS AIR 2400/241/SAFETY Page 1 of 23

Particle Testing Results:

The results are shown below (Tables 2 & 3) for particle measurements at the start (T0) and finish (T-4 hours) of each test and control run. The ISO Clean Room class for the start and finish of each particle test is listed per ISO 14644-14. The particle data shows the GPS Air 2400 and control testing starting as ISO Class 5 and finishing as ISO Class 6 which passes the ASHRAE Standard 241-2023 criteria of not increasing the ISO classification level beyond the next highest level.

Table 2: Duplicate particle measurement results with the GPS Air 2400 device operating

	Exp 1 - start	Exp 1 – end (4h)	Exp 2 - start	Exp 2 – end (4h)
Size (greater than)	**particles (#/m3)**	**particles (#/m3)**	**particles (#/m3)**	**particles (#/m3)**
0.3 µm	3213	35944	3219	46586
0.5 µm	1807	13655	1036	15270
1 µm	201	1004	0	1205
5 µm	0	0	0	0
ISO Clean Room Class	**5**	**6**	**5**	**6**

Formaldehyde Testing Results:

The results are shown below (Table 1) for Formaldehyde measurements at the start and finish of each test and control run. Emission Rate is shown as calculated from the concentration measurements. The emission rate for the GPS Air 2400 was calculated to be below the ASHRAE Standard 241-2023 requirement of 50 µg/hr.

Table 1: Duplicate Formaldehyde measurement results and emission rate calculations with and without the GPS Air 2400 device operating

	T0 - Start	T- 4 hours	Emission Rate
Test Run	**HCOC (µg/m3)**	**HCOC (µg /m3)**	**(µg /hr)**
Control 1	10.11	14.31	1.05
Control 2	17.21	19	0.4475
Experiment 1	13.71	16.71	0.75
Experiment 2	16.01	15.04	-0.2425

Ozone Testing Results:

The results are shown below (Table 4) for average ozone measurements for each test and control run. The ozone measurements for the GPS Air 2400 were all below the ASHRAE Standard 241-2023 target requirement (< 5 ppb).

Table 4: Average Ozone measurement results with the GPS Air 2400 device operating versus baseline control

	Ozone Measurements (average)
Test	**ppb**
Control	0.14
Experiment (4-hrs)	1.22
Net Increase	1.09

Certified High
Safety Standards

The comprehensive **third-party validation** framework is now **required** for air cleaners, ensuring consistent evaluation across technologies.

GPS Air products are safety tested and certified through **UL 2998** certification to verify no ozone or harmful byproducts.

Consequences of **Ozone**

ASHRAE Standard 62.1 states that ozone generation is undesirable and has a provision that **air cleaners be listed and labeled with UL2998.**

INDOOR AIR QUALITY

Lemon-Fresh Ozone

Ionization air purifiers may be making our homes and offices more unhealthy places when cleaning products leave the air smelling lemon-fresh, according to research in the 1 April 2007 issue of *Environmental Science & Technology*. Scientists at the University of California, Irvine, report that ozone emitted by these purifiers reacts with certain volatile organic compounds such as limonene, producing potentially harmful levels of particulate matter (PM).

"In earlier work we showed ionization air purifiers, which are meant to remove particles from the air, to be producers of ozone, which itself causes a range of breathing problems and perhaps reduced resistance to infections," says Sergey Nizkorodov, an assistant professor of chemistry at Irvine. "Now we show this ozone reacts with limonene entering the air from cleaning products to produce more PM than these machines can actually remove." Limonene is used to scent cleaning products.

The researchers placed an ionization air purifier in an office equipped with a standard air exchange system. An ozone generator—a type of purifier that releases ozone to oxidize and theoretically neutralize volatile pollutants—was used as a comparison. D-limonene was injected into the room periodically to achieve concentrations similar to those encountered in offices after cleaning.

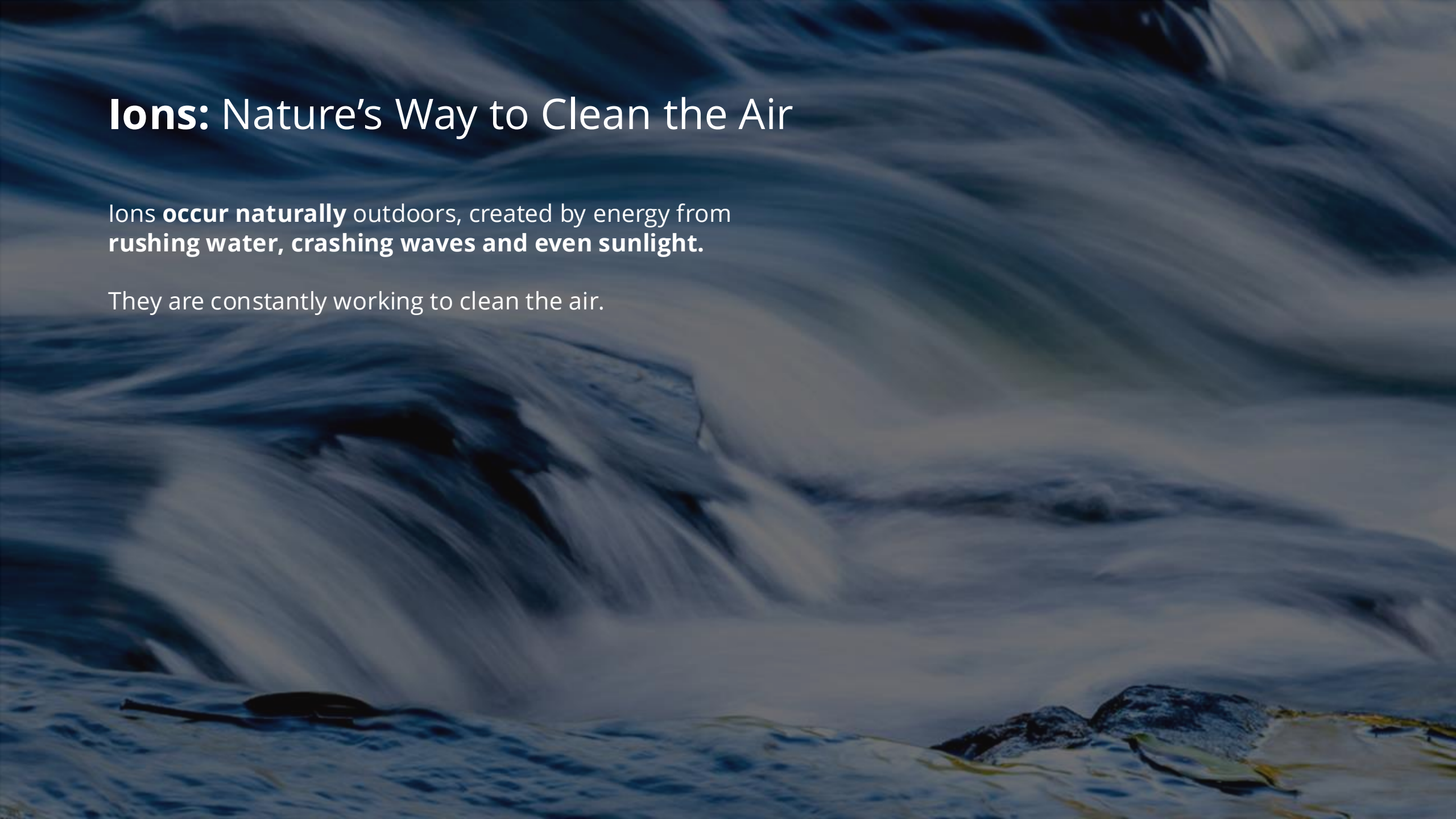
The ionization air purifier initially increased the ozone concentration by 5–15 ppb from a background level of 5 ppb, while the ozone generator raised it by some 250 ppb, according to Nizkorodov. With either machine operating, the limonene injections were accompanied by a spike of one to two orders of magnitude in the air's $PM_{2.5}$ and $PM_{0.1}$ content—from 10^3 to 10^5 particles per cubic centimeter—that decayed over the next hour. "This means that in [limonene's] presence, these air purifiers are actually air contaminators," says Nizkorodov.

The researchers also produced a kinetic model to predict the net amount of PM produced by different machines under different

"This means that in **limonene's presence,** these **air purifiers are** actually air **contaminators.**"

GPS®

Soft Ionization Clean Air Systems



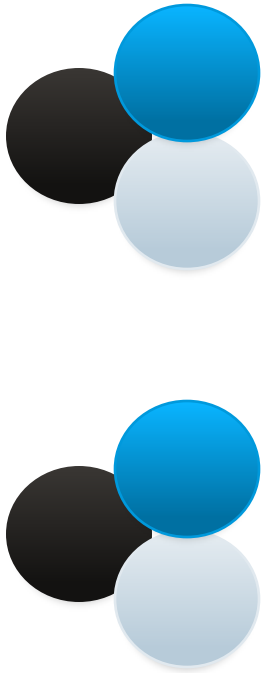
Ions: Nature's Way to Clean the Air

Ions **occur naturally** outdoors, created by energy from **rushing water, crashing waves and even sunlight.**

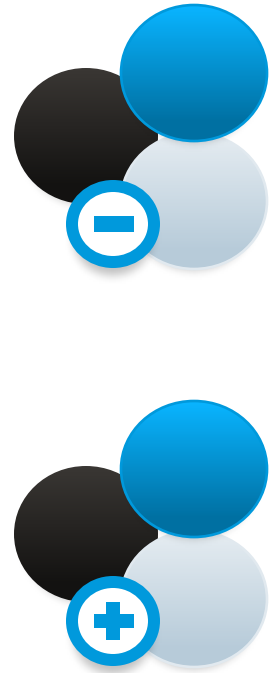
They are constantly working to clean the air.

GPS® Soft Ionization is a Safe Way to Create Ions

Airborne particles with net electric charge of **ZERO**



No changes in **chemistry** (low energy)



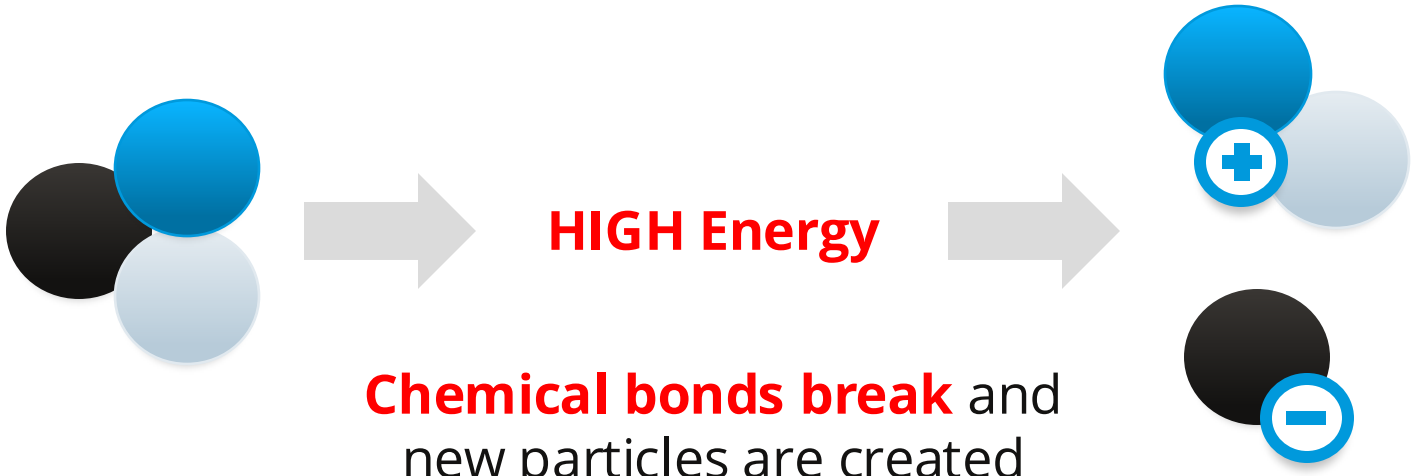
Same airborne particles with **net positive and negative** electric charge

F.T. Hartley and I. Kanik, "**A nanoscale soft-ionization membrane: A novel ionizer for ion mobility spectrometers for space applications**," Proceedings of the SPIE, 2002, Vol. 4936, pp. 43-49. DOI: 10.1117/12.484271 https://pubs.acs.org/doi/10.1021/acs.analchem.8b04437

Hard Ionization Leaves Byproducts Like **Ozone**

UVC, Dry H_2O_2, Dielectric Barrier Disc., and Photocatalytic Oxidation (PCO) all use hard ionization.

Airborne particles with net electric charge of **ZERO**



Chemical bonds break and new particles are created

New particles potentially created:

- **Ozone**
- **Formaldehyde**
- **Unknown?**

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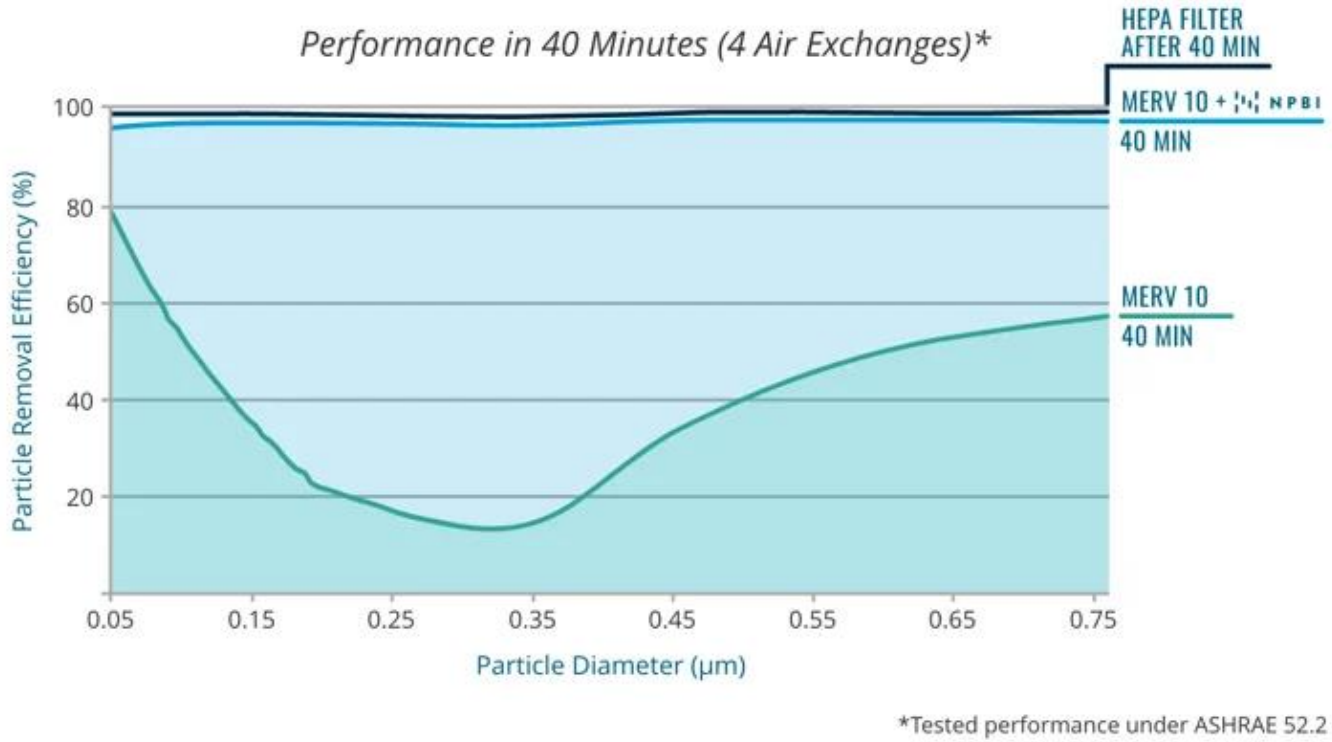
Atmosair DBD BPI vs Needlepoint BPI Position Document, excerpt from Dr. Stacy Daniels.

GPS® Assists in **HVAC Filtration**

The opposite-polarity particles charged by NPBI attract one another, allowing **small particles to become larger and easier to capture.**



Proven **Pathogen Reduction**

Independent testing confirms GPS technology **effectively reduces SARS-CoV-2, Influenza, and other pathogens.**

For more information about third-party testing, visit GPS Air | Third Party Testing.

Surface Testing

Specimen	Avg. Ion Density (ions/cc)	% Net Reduction	
		30 minutes	**60 minutes**
SARS-CoV-2	-9,700	55.50%	62.85%
	-10,250	55.94%	70.71%
	-20,600	97.90%	99.97%
	-23,600	98.49%	99.98%
SARS-CoV-2 Delta Variant	-22,000	54.04%	98.70%
Staphylococcus Aureus	-14,000	36.61%	91.55%
E. Coli	-14,000	31.46%	86.36%
MRSA	-14,000	44.91%	87.87%

In-Air Testing

Specimen	Avg. Ion Density (ions/cc)	% Net Reduction	
		30 minutes	**60 minutes**
SARS-CoV-2	-10,000	40.78%	90.87%
	-18,000	65.38%	98.33%
Influenza A	-22,000	43.13%	84.53%
Influenza B	-22,000	32.71%	83.93%
RSV	-22,000	49.52%	94.71%

Unmatched Small Particle & Pathogen Management with Soft Ionization.

Integrated NPBI technology efficiently reduces fine particles **including viruses, bacteria, and pollutants,** further improving indoor air.

NPBI

GPS® Solutions:
HVAC Applications

Maintenance Free

Low Power <15W

Quiet Operation

UL 2998

Standard 241 Appendix A Safety
Ozone, Formaldehyde, PM2.5

Effective on Pathogens, Odors, & Particles
Third party SARS-CoV-2 results
with Standard 241 protocol

Integrated Magnets (some models)

CI-2

DM-2

DM48

FC24

FC48

GPS® Solutions:
In-Space Applications

Maintenance Free

Low Power

Quiet Operation

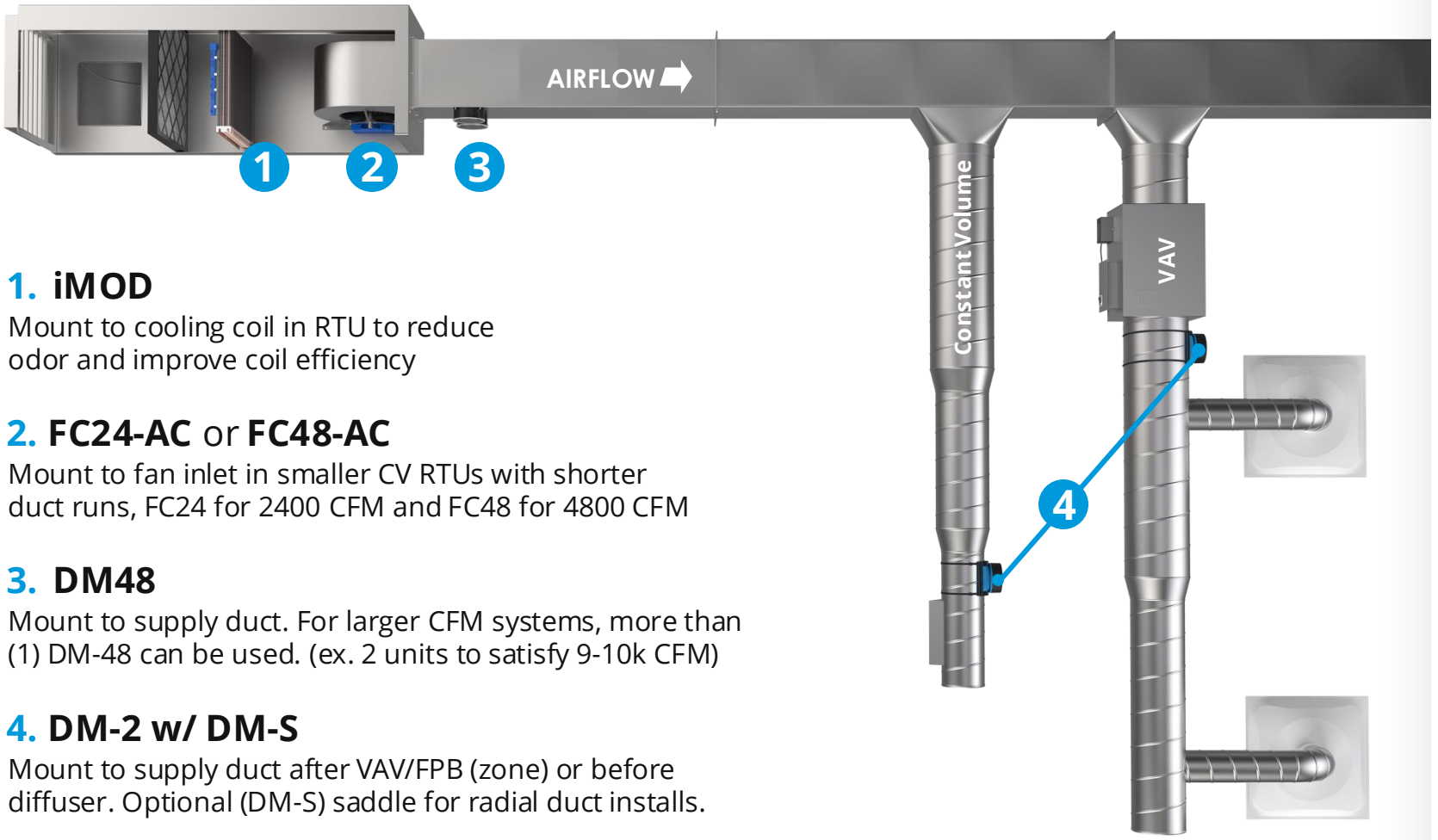
UL 2998

Standard 241 Appendix A Safety
Ozone, Formaldehyde, PM2.5

Effective on Pathogens, Odors, & Particles
Third party SARS-CoV-2 results
with Standard 241 protocol

Integrated NPBI

Solutions for **All Types of Applications**

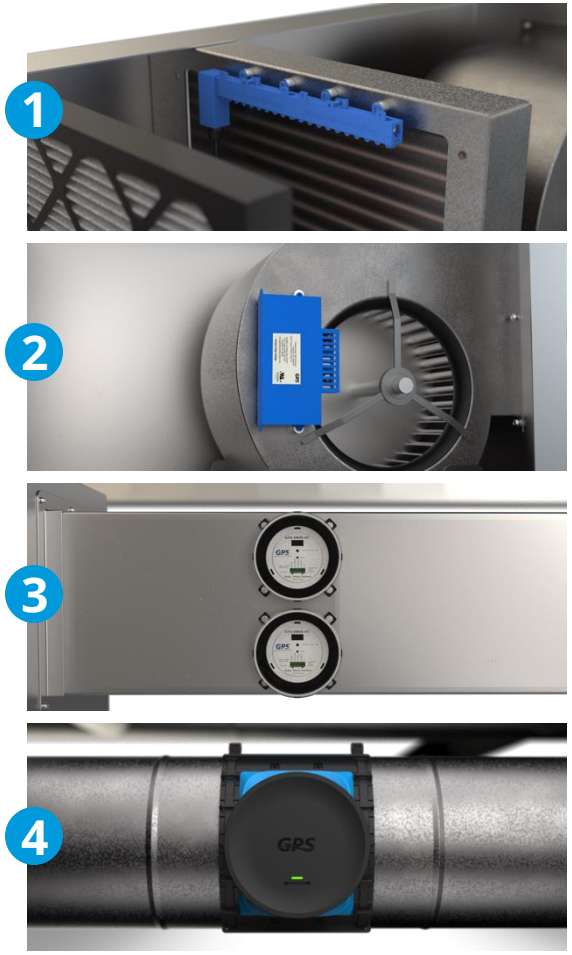


1. iMOD
Mount to cooling coil in RTU to reduce odor and improve coil efficiency

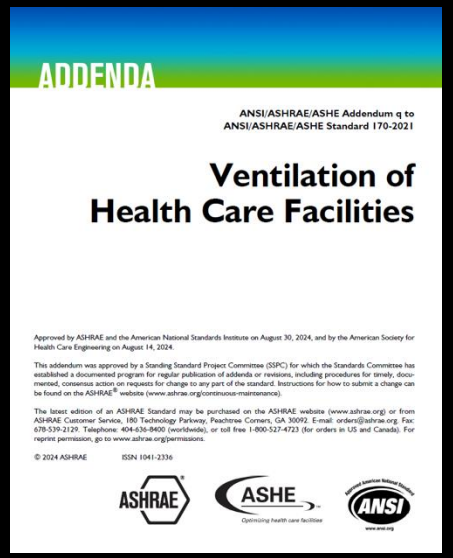
2. FC24-AC or FC48-AC
Mount to fan inlet in smaller CV RTUs with shorter duct runs, FC24 for 2400 CFM and FC48 for 4800 CFM

3. DM48
Mount to supply duct. For larger CFM systems, more than (1) DM-48 can be used. (ex. 2 units to satisfy 9-10k CFM)

4. DM-2 w/ DM-S
Mount to supply duct after VAV/FPB (zone) or before diffuser. Optional (DM-S) saddle for radial duct installs.



Evolving air quality standards for healthcare.



Informative Appendix E: A Hospital's emergency plan requires every patient room on the fourth floor to be convertible to a "pandemic mode" consistent with ASHRAE Standard 241.

-Standard 170 Addendum Q

Translation: design in additional air cleaning for airborne particles beyond what is required by the standard.

What **Our Customers** Say

Nothing speaks louder than **results.** Our customers have found **practical, cost-effective** ways to **solve their indoor air quality** challenges using GPS Air technology.

Their experiences showcase the **real-world impact of our approach** across diverse facilities and applications.

"The results were just **astounding** on how well GPS was handling the air quality."

Marty Hamilton

Associate VP of Financial Administration, Southern Adventist University

“We ordered just over a thousand [IDF-2] units…**it was the right move to make for our school district.**”

Ted Lambert

Supervisor of Facilities, Colonial School District

"During the **Canadian wildfires**, you could smell smoke and burned wood outdoors. The sky had a haze to it from the smoke. It was enough to irritate your eyes and nose.

To my surprise our office indoor air quality was fresh and clean smelling; even my eyes were no longer irritated."

Todd Kocsis

General Manager, Campbell Mechanical Services Inc

Resources

- ASHRAE Standard 90.1 Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings
- ASHRAE Guideline 42 Enhanced Indoor Air Quality for Commercial and Institutional Buildings
- ASHRAE Standard 62.1 Ventilation for Acceptable Indoor Air Quality
- U.S. Green Building Council LEED® v4.1, 5.0
- WELL Building Standard
- ASHRAE Standard 52.2
- ASHRAE Standard 145.2
- ASHRAE Standard 241
- ASHRAE Fundamentals Handbook
- ASHRAE Journal article "IAQ & Energy Impact of Exhaust Air Transfer"
- ASHRAE Position Document on Limiting Indoor Dampness and Mold in Buildings.

GPS

gpsair.com

Needle Point Bipolar Ionization (NPBI®) Specification Support

GPS Air offers a wide range of NPBI products that support air quality and outside air reduction under the Indoor Air Quality Procedure in ASHRAE Standard 62.1. GPS Air is the leader in this product category with unrivaled development, data, science, and product evolution. As a reminder, local codes and requirements must always be applied for safe and effective use of the products. Some basics on NPBI can be found here: NPBI technology

Safety First

NPBI products from GPS Air use soft ionization to create positive and negative charged ions. Soft ionization operates below the power threshold that leads to ozone generation and other unhealthy byproducts. Therefore, GPS Air products do not "create chemistry in the air". These safety claims are validated as follows:

- **Certified to UL 2998**
  UL 2998 is an environmental testing standard that allows manufacturers to demonstrate that device ozone levels stay below the quantifiable limit of detection of 0.005 ppm (5 ppb). This is important because ozone in the presence of other chemicals, particularly common commercial cleaners, reacts to form formaldehyde.
- **Validated Safe by ASHRAE Standard 241 Safety Testing (Appendix A)**
  Standard 241 directs the use of an independent, third party laboratory to evaluate the safety of an air cleaner. The rigorous testing is summarized in a report to prove the air cleaner is UL2998 compliant, generates formaldehyde at a rate less than 50µ/hr, and generates particles to less than 1 ISO class more than the starting classification. GPS Air NPBI modules passed: less than 1ppb increase in ozone, formaldehyde generation of 0.5µg/h, and particle generation to less than 1 ISO class.
- **Certified to UL 867**
  UL867 is a safety standard for electrostatic air cleaners that attests to the construction, performance and electrical safety of GPS Air products.
- **Certified to UL 2043**
  UL 2043 is a safety standard that evaluates the fire and smoke characteristics of products, ensuring they are safe for use in plenum air-handling spaces.
- **FCC Part 18 Certified**
  Verifies that radio frequency emissions are below federal thresholds to protect registered communication bands for telecommunications equipment (no interference with cellphones and radios).
- **CARB Certified**
  Passes stringent California standards required for air cleaners, allowing them to be used in residential and commercial applications. This is more stringent than the "zero ozone" criterion.

Safety is clearly a priority for GPS Air. We make all test reports public on our website and we will email reports to anyone who requests via our website.

Join Us at Our **Experience Center.**

Scan for a look into our Experience Center.