What We Know

ABOUT SARS-COV-2 TRANSMISSION INDOORS

Article Highlights:

(1) **Scientific research** concluding that most very small particles and pathogens (like SARS-CoV-2 and other viruses) are of insufficient mass to be controlled by bulk airflow and can remain suspended in the indoor air for days or even weeks.

(2) **Computational fluid dynamics** (CFD) simulation performed in an office space showing a "cloud" of virus transmission never reaches the mechanical system where filters could be effective.

(3) **Recent ASHRAE Journal publications** that suggest emerging research has not provided evidence of the transmission of SARS-CoV-2 virus through HVAC systems, although within a space, air motion caused by HVAC system components as well as fans can be a factor. This may essentially negate the need for in-duct or air system control technologies such as UV lights.

(4) **Latest CDC COVID-19 guidance** on virus transmission through HVAC systems which states that the risk of spreading SARS-CoV-2 through ventilation systems is not currently clear, and that while airflows within a particular space may help spread disease among people in that space, there is no definitive evidence to date that viable virus has been transmitted through an HVAC system to result in disease transmission to people in other spaces served by the same system.

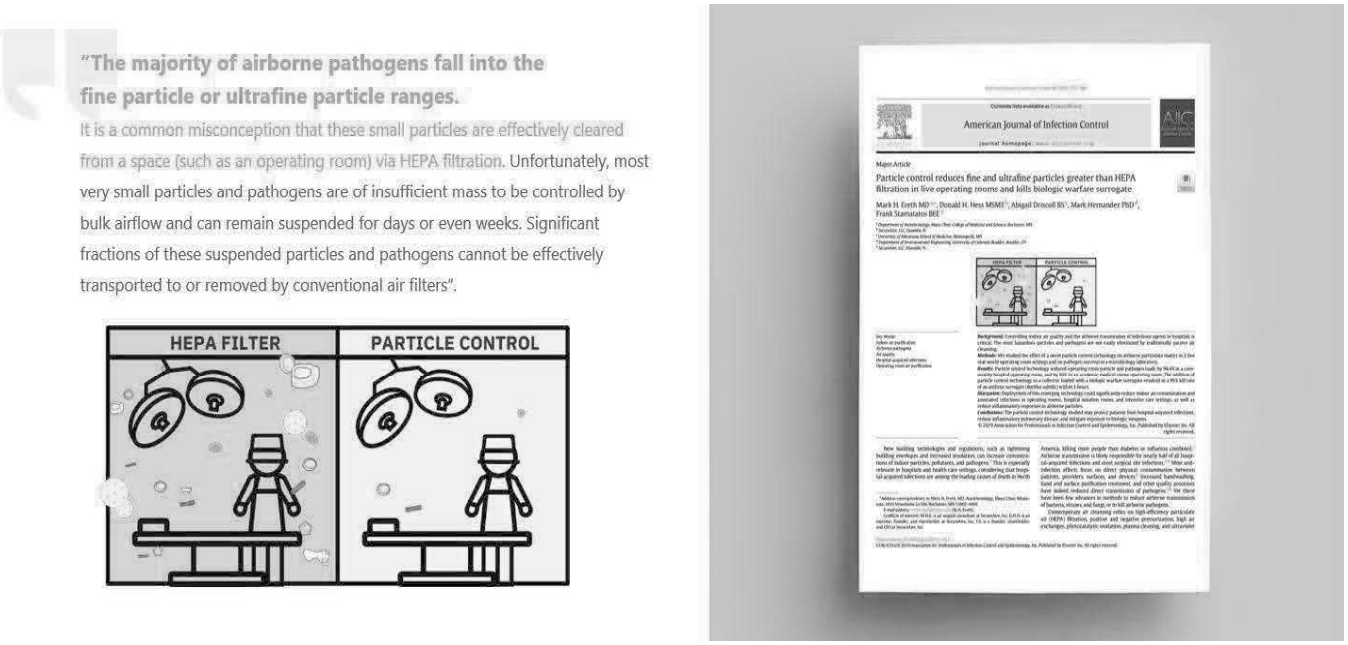
(5) **Recent findings by Purdue University** College of Engineering on how wearing masks indoors may reduce infection risk by 50%, and that by implementing Biploar Ionization in the space it may be possible to reduce transmission rates an additional 20%-30%.

(6) **Strategies to help improve** the efficacy of traditional ventilation and filtration, and that work on the contaminants and pollutants in the space where we are being told the issues of concern may originate and remain until treated and remediated.

There is much we have yet to learn about the virus SARS-CoV-2 that causes the disease COVID-19. We do not know, for example, when an infected individual breathes, talks, coughs, or sneezes into the air how many actual virons are encapsulated in the respiratory droplets that are emitted into the surrounding environment. We do not know how may virons it takes to cause an infection when a susceptible host in that same environment inhales these respiratory droplets. While these are questions that may take considerable time to be answered, it is surprising how much information we have garnered in a relatively short period about how the virus is being transmitted indoors.

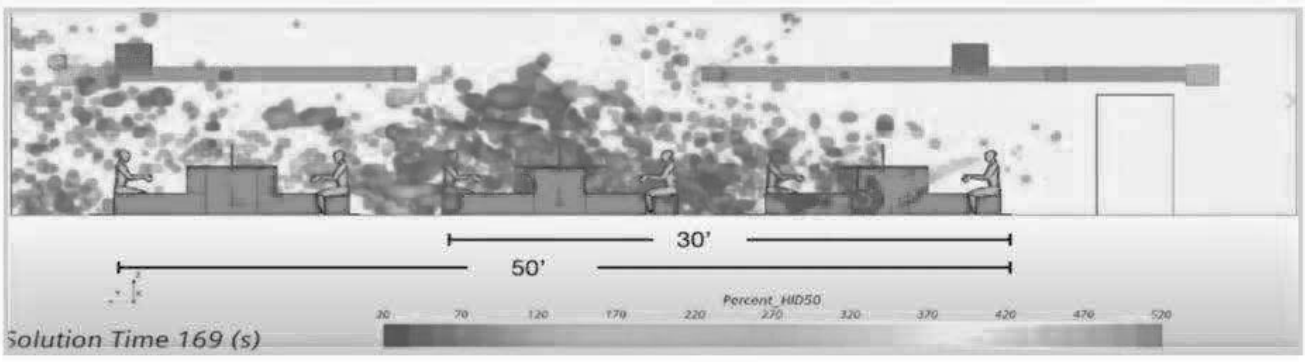
We do know it can be spread via airborne transmission between individuals within built environments. Guidance has been disseminated by several agencies including the **Centers for Disease and Control** (CDC), the **World Health Organization** (WHO), the **American Society of Heating, Refrigeration and Air Conditioning Engineers** (ASHRAE) to help us reduce this risk. Information has been updated and revised,

culminated here into what is most currently available. Some of the latest and most important is shared in the paragraphs that follow.



In 2019 a major article was published in the **American Journal of Infection Control** titled Particle Control Reduces Fine and Ultrafine Particles Greater than HEPA Filtration in Live Operating Rooms and Kills Biological Warfare Surrogate, authored by experts in the field of medicine, aerosol science, filtration, and HVAC. The document states "*The majority of airborne pathogens fall into the fine particle or ultrafine particle ranges. It is a common misconception that these small particles are effectively cleared from a space (such as an operating room) via HEPA filtration.* ***Unfortunately, most very small particles and pathogens are of insufficient mass to be controlled by bulk airflow and can remain suspended for days or even weeks. Significant fractions of these suspended particles and pathogens cannot be effectively transported to or removed by conventional air filters****".* The authors concluded that controlling indoor air quality and the airborne transmission of infectious agents is critical, and that the most hazardous particles and pathogens are not easily eliminated by traditionally passive air cleansing technologies.

In July of 2020 Holt Architects and ME Engineers combined talents to perform a computational fluid dynamics (CFD) simulation of Holts workspace, showing how infected droplets might move through their studio. A person coughing 3-times in a 10-minute period was shown to produce a cloud of infective aerosols that could be carried more than 50-feet across the space. In conclusion to the simulation Steven W. Hugo, AIA and principle at Holt stated ***"Finally, notice that the cloud of virus never reached the mechanical system where filters could be effective".*** Video available at https://www.youtube.com/watch?v=3I3G4HN2MEs



CFD study of infected person coughing 3-times in 10-minutes, a cloud of infective aerosols is carried > 50 feet

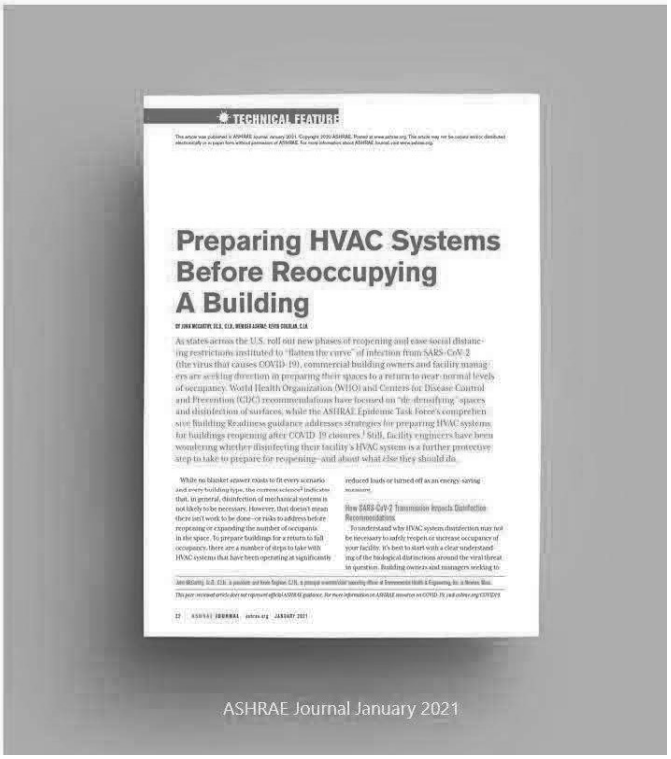
In the November 2020 **ASHRAE Journal** an Industry News interview was published which talked about the ASHRAE Epidemic Task Force and its work in keeping up with the latest information on the virus. With a goal to provide guidance on reducing airborne exposure, it was noted that **emerging research has not provided evidence of the transmission of SARS-CoV-2 virus through HVAC systems**, **although within a space, air motion caused by HVAC system components as well as fans can be a factor**.

The January 2021 **ASHRAE Journal** printed a peer reviewed article titled Preparing HVAC Systems Before Reoccupying A Building which discussed WHO and CDC recommendations, along with the ASHRAE Epidemic Task Force's comprehensive Building Readiness guidance for preparing HVAC systems for buildings reopening after COVID-19 closures. The authors noted that *"The growing science around far-field aerosol transmission* ***essentially negates the need for in-duct or air system control technologies such as UV lights.*** *While these products and services may serve a useful function, in most applications,* ***they may not meet the specific need that's called for in mitigating the hazards of SARS-CoV-2".***

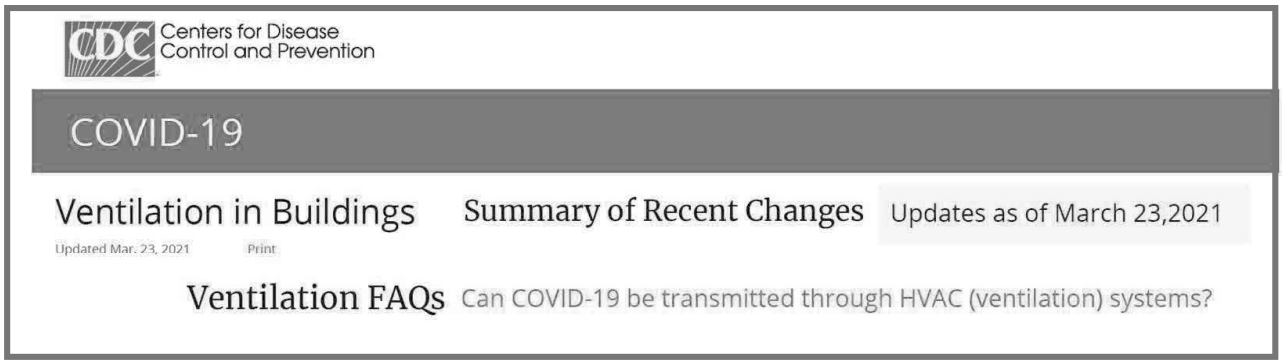
"The growing science around far-field aerosol transmission essentially negates the need for in-duct or air system control technologies such as UV lights. While these products and services may serve a useful function, in most applications, they may not meet the specific need that's called for in mitigating the hazards of SARS-CoV-2".

"Of course, *specialized applications may exist* where added levels of in-space or in-room protection may be useful, most notable in health-care and long-term of senor care facilities".

Preparing HVAC Systems Before Reoccupying A Building, ASHRAE Journal January 2021



Theses authors went on to conclude that *"Of course, specialized applications may exist where added levels of* ***in-space or in-room protection may be useful****, most notable in healthcare and long-term of senior care facilities".*



On March 23, 2021, the CDC released updated COVID-19 guidance on virus transmission through HVAC systems which stated the following: ***"The risk of spreading SARS-CoV-2, the virus that causes COVID-19, through ventilation systems is not clear at this time****. Viral RNA has reportedly been found on return air grilles, in return air ducts, and on heating, ventilation, and air-conditioning (HVAC) filters, but detecting viral RNA alone does not imply that the virus was capable of*

transmitting disease. One research group reported that the use of a new air-sampling method allowed them to find viable viral particles within a COVID-19 patient's hospital room with good ventilation, filtration and ultraviolet (UV) disinfection (at distances as far as 16 feet from the patient). However, the concentration of viable virus detected was believed to be too low to cause disease transmission. There may be some implications for HVAC systems associated with these findings, but it is too early to conclude that with certainty. ***While airflows within a particular space may help spread disease among people in that space, there is no definitive evidence to date that viable virus has been transmitted through an HVAC system to result in disease transmission to people in other spaces served by the same system".***

Proper ventilation and filtration are pillars of a well-designed HVAC system and paramount to creating productive indoor environments, but this recent information on how SARS-CoV-2 may be transmitted indoors could be an indication that traditionally mounted HVAC system air-cleaning devices may not be as effective in helping reduce an occupant's exposure to indoor airborne contaminants as hoped or anticipated. The virus may be staying in the space as an (aerosolized) droplet nuclei, suspended in the breathing zone indefinitely, possibly remaining infectious for up to several hours. Consideration of treating the contaminants of concern in the space itself may be prudent when implementing an effective strategy to create synergy between indoor social distancing measures (temperature scanning, masks, physical separation, etc.) and an HVAC system that adds an additional layer of occupant protection. **Effective air cleaning technology installed within the HVAC system should be capable of reaching out into the space itself, treating the contaminants there, then hopefully removing them so they are no longer an environmental risk to occupants**.

On November 11th, 2020, **Purdue University College of Engineering** hosted a webinar event titled Virus Transmission and Mitigation in Buildings, Past, Present and Future. A panel of experts in this field, including Dr. Qingyan Chen, Professor of Mechanical Engineering at Purdue University, addressed a variety of issues relevant to virus transmission and mitigation in buildings, including developing an understanding of mechanisms for transmission informed by previous and evolving studies, short-term mitigation strategies that have been developed to address the COVID-19 pandemic, impacts of mitigation strategies on energy use and operation of buildings, and future "virus-proof" designs and strategies for buildings.

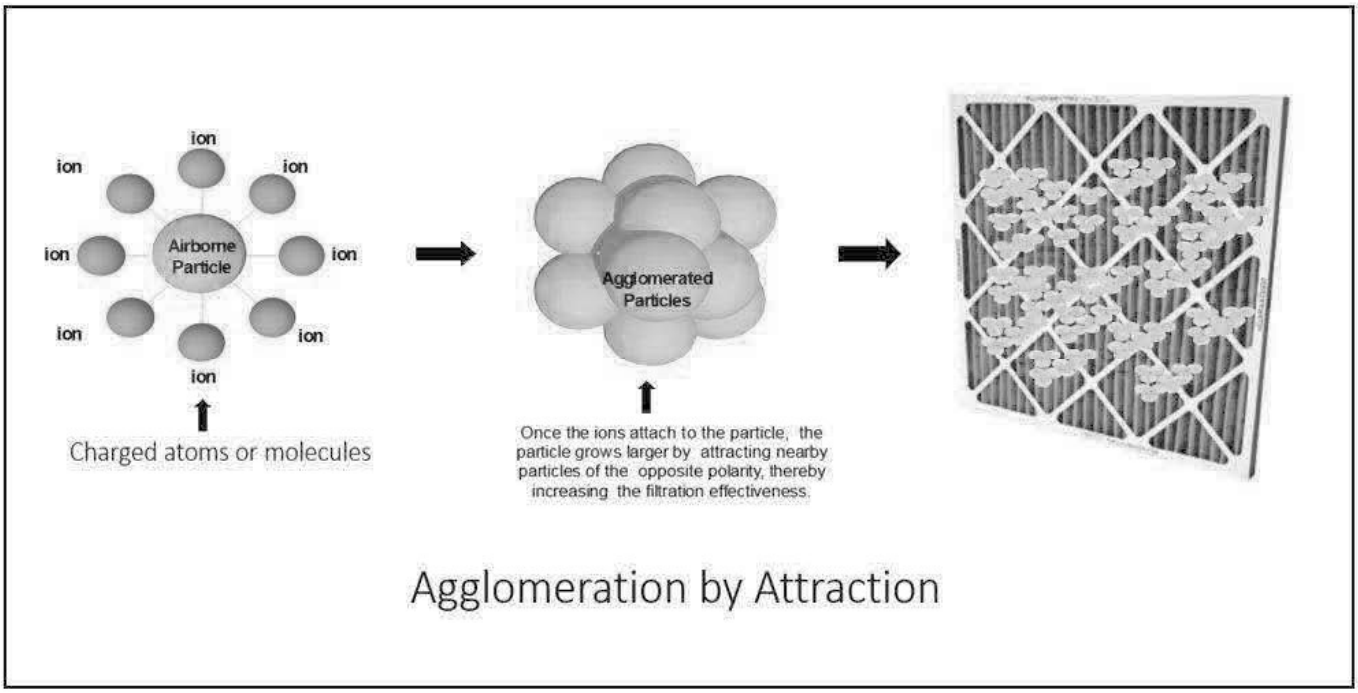
A link to a recording of the event is provided below:
https://engineering.purdue.edu/Engr/rising-to-the-challenge/Events/covid19-impacts-and-strategies-for-buildings

Dr. Chen presented finding on how wearing masks indoors may reduce infection risk by 50%, and that **by implementing Biploar Ionization in the space it may be possible to reduce transmission rates an additional 20%-30%** (time mark 13:28 minutes). This latest information may help buildings everywhere become better equipped to deal with the pandemic and keep occupants safer, healthier, and more productive.

We should not fail to recognize this latest guidance when formulating actions to help remediate the threat of SARS-CoV-2 transmission within buildings. What you know and fail to acknowledge (or implement) may hurt both you and others. This most recent information tells us that traditional HVAC ventilation and filtration strategies may have reduced impact on cleaning the indoor environment because the small pollutants of concern cannot be moved out of the space and into the HVAC system to be exhausted, filtered, or treated. Something different than what we are doing now may warrant consideration.

It is obvious that air cleaning devices installed within the HVAC system (regardless of the technological platform) should do more than wait for virus laden air to get to it for treatment. Easily understood is the simple concept that if the pollutants in the space are removed, they are no longer a health concern. This should be a major accomplishment for all HVAC air cleaning systems moving forward. The question now becomes, how can we most successfully and cost effectively accomplish this task?

Needlepoint Bipolar Ionization (NPBI) is a patented air cleaning technology that can be mounted in the HVAC system but works on the contaminants and pollutants in the space, where we are being told the issues of concern may originate and remain until treated and remediated. NPBI can help supplement traditional ventilation and filtration by influencing the removal of small airborne particulate (viruses, pathogens, and other contaminants) from the environment based on the principle of electrostatic attraction (agglomeration). Ions, like those already prevalent in cleaner outdoor air, are generated within the HVAC system so that when released and distributed throughout the building can mix with room air and attach (electrostatically) to airborne particles. As these charged particles are increasingly attracted and joined to one another, their size and weight is increased to the point where they are now larger and heavy enough to be influenced by HVAC system air movement. They can then be effectively removed from the space and exhausted, filtered, or treated. Air filters now become more efficient at removing these larger particles from the air, while internally mounted HVAC air purification devices can encounter the pollutants they have been tasked with cleaning, those which before had always remained in the space untouched.



NPBI has been successfully used in cleanroom applications to help reduce airborne particle counts and create the cleanest indoor environments possible for critical healthcare, pharmaceutical, semiconductor, food processing, and manufacturing processes. Many studies have demonstrated that air ionization is efficient at removing aerosols and particles from the environment, proving significant reductions in contaminant concentrations.

In addition to NPBI helping rid indoor environments of particulate, it can provide additional IAQ benefits by inactivating viruses, breaking down volatile organic compounds (VOC's), remediating odors, and killing certain pathogens. Applied upstream of wet cooling coils, it helps eliminates issues with biofilm and microbial growth in HVAC air-handling systems. Laboratory tests of GPS' NPBI demonstrate reductions in harmful pathogens, including human coronavirus, SARS-CoV-2 (COVID-19), and an array of others.

Pathogen	Time in Chamber	Rate of Reduction	Test Agency
SARS-CoV-2**	30 minutes	**99.8%** Inactivation rate measured on aluminum and other surfaces	Innovative Bioanaylsis

Please note that testing the reduction rate of SARS-Cov-2 with GPS' NPBI product is an evolving process and additional testing is anticipated to be conducted in the future. While this is not a surface disinfectant, this testing demonstrates a decrease in active virus on surfaces through particle aggregation.

† Surrogate for Norovirus, actual strain tested was Feline Calicivirus, ATCC VR-782; Strain F-9
*Human Coronavirus 229 is not SARS-CoV-2
**Not an FDA Cleared Air Purification System

Global Plasma Solutions (GPS) uses multiple data points to formulate performance validation statements. GPS technology is used in a wide range of applications across diverse environmental conditions. Since locations will vary, clients should evaluate their individual application and environmental conditions when making an assessment regarding the technology's potential benefits.

The use of this technology is not intended to take the place of reasonable precautions to prevent the transmission of pathogens. It is important to comply with all applicable public health laws and guidelines issued by federal, state, and local governments and health authorities as well as official guidance published by the Centers for Disease Control and Prevention (CDC) (https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html), including but not limited to social distancing, hand hygiene, cough etiquette, and the use of face masks.

BSL 3 Testing Lab

Independent Testing by EMSL, ALG, & Innovative Bioanalysis

Pathogen	Time in Chamber	Rate of Reduction	Test Agency
Tuberculosis	60 minutes	**69.1%**	EMSL
MRSA	30 minutes	**96.2%**	EMSL
Staphylococcus	30 minutes	**96.2%**	EMSL
E.coli	15 minutes	**99.7%**	EMSL

Pathogen	Time in Chamber	Rate of Reduction	Test Agency
Norovirus†	30 minutes	**93.5%**	ATS Labs
Human Coronavirus 229E*	60 minutes	**99.0%**	Analytical Lab Group
Legionella	30 minutes	**99.7%**	EMSL
Clostridium Difficile	30 minutes	**88.9%**	EMSL

ASHRAE states that "All retrofits and modifications must not contradict ASHRAE 62.1 guidelines and must continue to meet code". ASHRAE 62.1 specifically states that (electrically powered) air-cleaning devices that generate ozone are prohibited, and all air cleaning devices shall be listed and labeled in accordance with Underwriters laboratory UL2998 (for zero ozone emission). This is a very important consideration when making decisions on air cleaning technologies serving any occupied indoor environment. GPS-NPBI technology will not introduce ozone into the surrounding environment.

GPS & NPBI TECHNOLOGY FAST FACTS

- Laboratory tests of GPS' NPBI demonstrate reductions in harmful pathogens, including human coronavirus and SARS-CoV-2 (COVID-19).
- GPS technology reduces pathogens by disrupting their surface proteins, rendering them inactive and unable to replicate. A misnomer is that this process kills viruses; rather, it deactivates them, so they are no longer infectious.
- GPS technology reduces the volume of infectious airborne pathogens to make air cleaner and safer to breathe.

- GPS technology will not introduce ozone into the surrounding environment. This technology is validated to UL2998 for zero ozone emission.
- GPS technology can help reduce carbon footprints, increase energy savings, and eliminate odors. This can also contribute to reduced levels of pollution in the outdoor air.
- GPS technology should be used in conjunction with public health laws and guidelines, including but not limited to social distancing, hand hygiene, cough etiquette and the use of face masks.
- Unlike alternative technologies that require routine replacement of lightbulbs, tubes, or filters, GPS' NPBI requires no replacement parts for the life of the product.

Authors Bio:

David Schurk DES., CEM., LEED-AP., CDSM., CWEP., SFP., CIAQM., HCCC., is Business Development Manager for Global Plasma Solutions in Charlotte, NC (USA). He is a Licensed Designer of Engineering Systems and has over 35-years of experience in the design and analysis of heating, ventilating, and air-conditioning systems for a variety of market sectors, with a special focus on healthcare facilities. David has authored various technical articles for several industry trade journals and magazines, along with being a featured presenter at regional and national industry events. He can be reached at david.schurk@globalplasmasolutions.com and 920-530-7677.