Beware
The COVID-19 Snake Oil Salesmen Are Here

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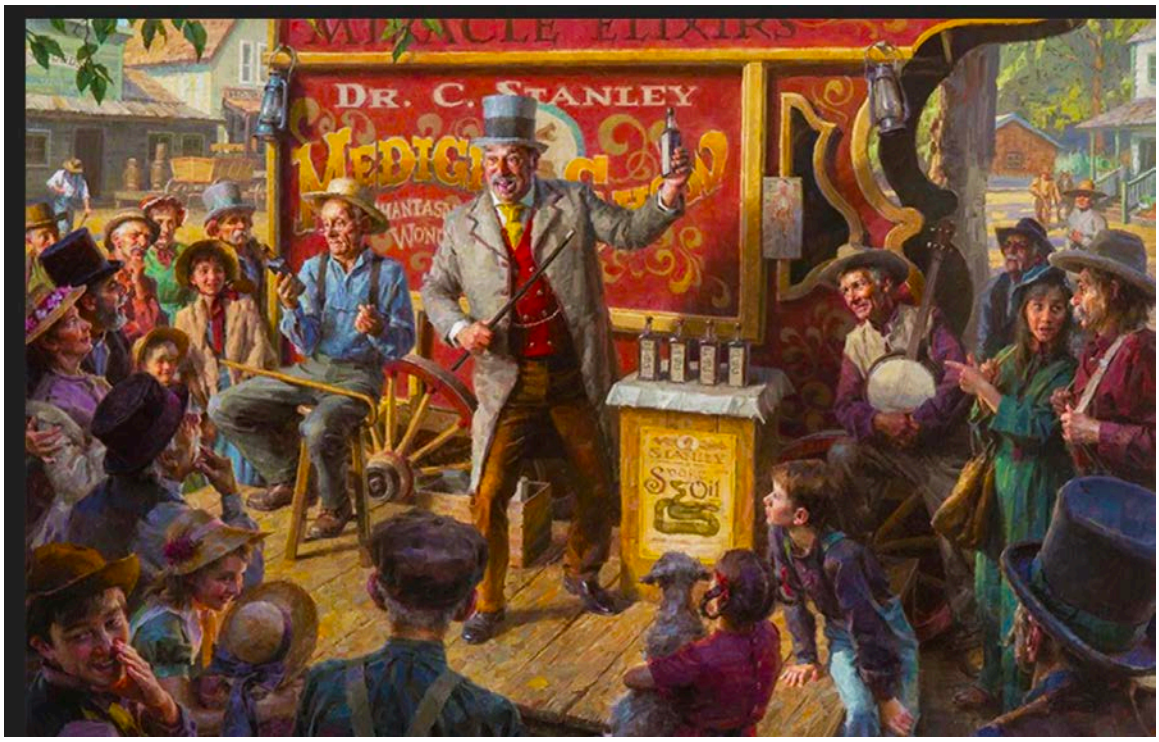
The snake oil salesmen are here and they are out to sell you air cleaners that promise to eliminate the SARS-CoV-2 airborne virus that causes COVID-19. Beware, at best these air cleaners provide little to no removal of airborne virus and may actually produce dangerous chemicals, such as ozone and formaldehyde.



The Snake Oil Salesman (Morgan Weistling)

Many of these air cleaners claim to use electrostatic effects (e.g., bipolar ionization, negative ion generation, cold plasma, etc.) to reduce indoor air contaminants, including virus and bacteria, by more than 98%. These air cleaners are not new, and have been re-incarnated many times since the early 1900s. I have reviewed test data from many of these devices and I have never found that these devices significantly remove air contaminants from the indoor air.

Nor should we expect these ionization devices to have a significant effect on airborne concentrations. While ionization of air can increase the deposition rates of particulates onto indoor surfaces, this effect is small compared to the overall removal by ventilation and filtration, and hence ionization does not significantly reduce indoor concentrations.

Regarding bipolar ionization, ASHRAE states in "Filtration/Disinfection" (https://www.ashrae.org/technical-resources/filtration-disinfection)

Bipolar Ionization/Corona Discharge / Needlepoint Ionization and Other Ion or Reactive Oxygen Air Cleaners

"Convincing scientifically-rigorous, peer-reviewed studies do not currently exist on this emerging technology; manufacturer data should be carefully considered."

So let's do just that, and look carefully into the manufacturer's test data behind one of these ionization devices.

I have been conducting performance tests of air cleaning devices for 30 years and served as an expert witness and special consultant for the U.S. Federal Trade Commission regarding the performance claims found in advertisements of portable air cleaners and residential furnace filters. I also provided consultation to the American Home Appliance Manufacturers (AHAM) on the development of a standard for testing portable air cleaners, AHAM Standard AC-1, which is used to measure the Clean Air Delivery Rates (CADR) for air cleaners.

I have selected Global Plasma Technologies (GPS), which sells a product advertised as "Needlepoint Bipolar Ionization (NPBI ^{TM})"

I note that there are similar devices by other manufacturers that advertise "Needlepoint Bipolar Ionization (NPBI)", and I have selected GPS as an example for this technology as there were more test data available for this product. Our analyses of the test data for other ionization devices, including negative ion generators and electrostatic filters, indicate indoor contaminant removal capabilities similar to those determined below for the GPS system.

The GPS ionization system is an electrostatic ionization bar and power supply that is installed in the HVAC system. According to GPS, the "optimal location to mount the GPS-iMOD is between the filter and the cooling coil". The cost of an GPS-iMOD ionization bar and power supply is approximately $3,000 - $4,000

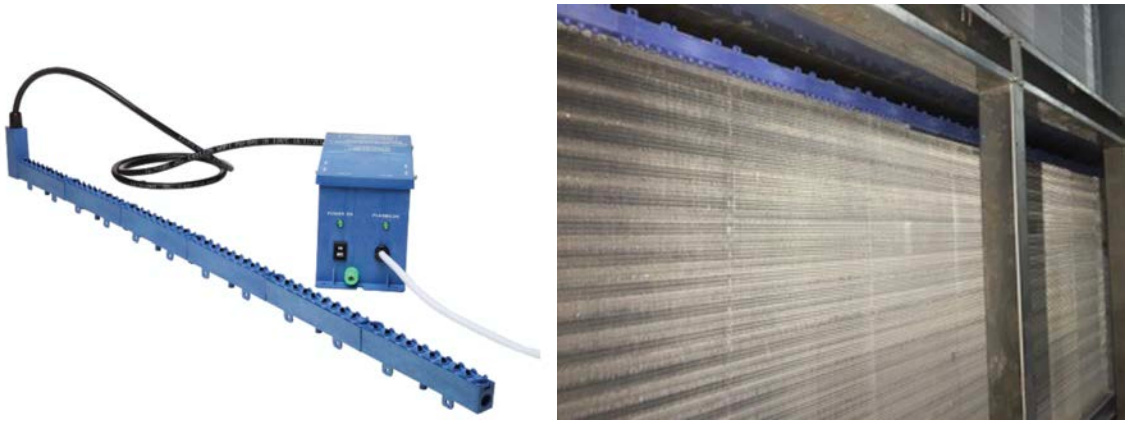
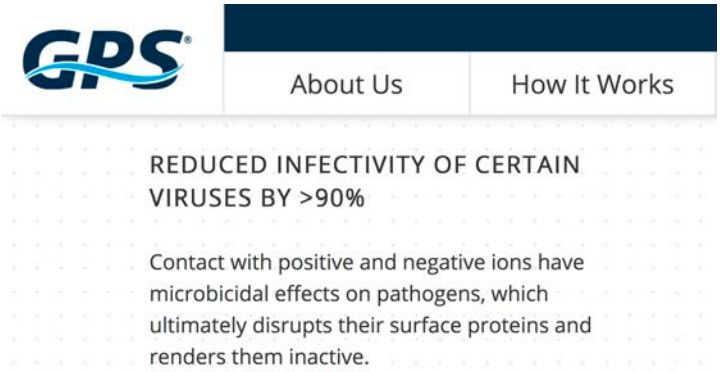


Figure 1. Photo of a GPS-iMod ionizer bar on left with power supply and an installation above the cooling coil of an HVAC system.

According to the GPS web page;

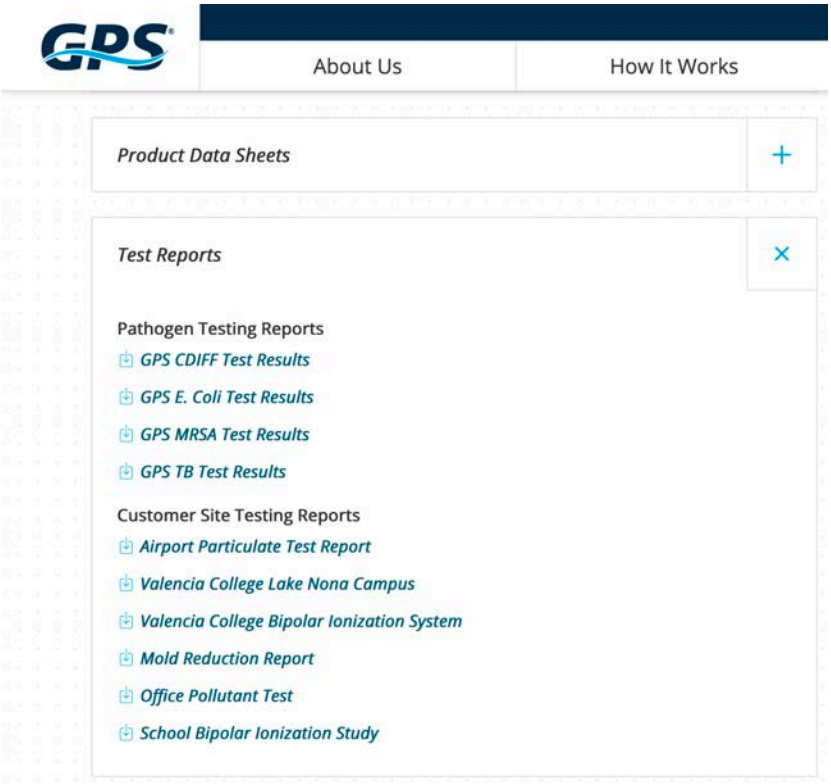
"GPS' NPBI technology safely cleans indoor air. This patented technology produces a high concentration of positive and negative ions, delivering them to the space via the ventilation system. Within the air stream, ions attach to particles, where they combine, become larger and are more easily filtered from the air. When ions come in contact with pathogens, they disrupt the pathogens' surface proteins, rendering them inactive."

Also, according to the GPS web page and specific to virus;



So what test data does GPS have to support that installation of a GPS ionizer into an HVAC system reduces the indoor airborne concentrations of virus, bacteria, or any other air contaminants ?

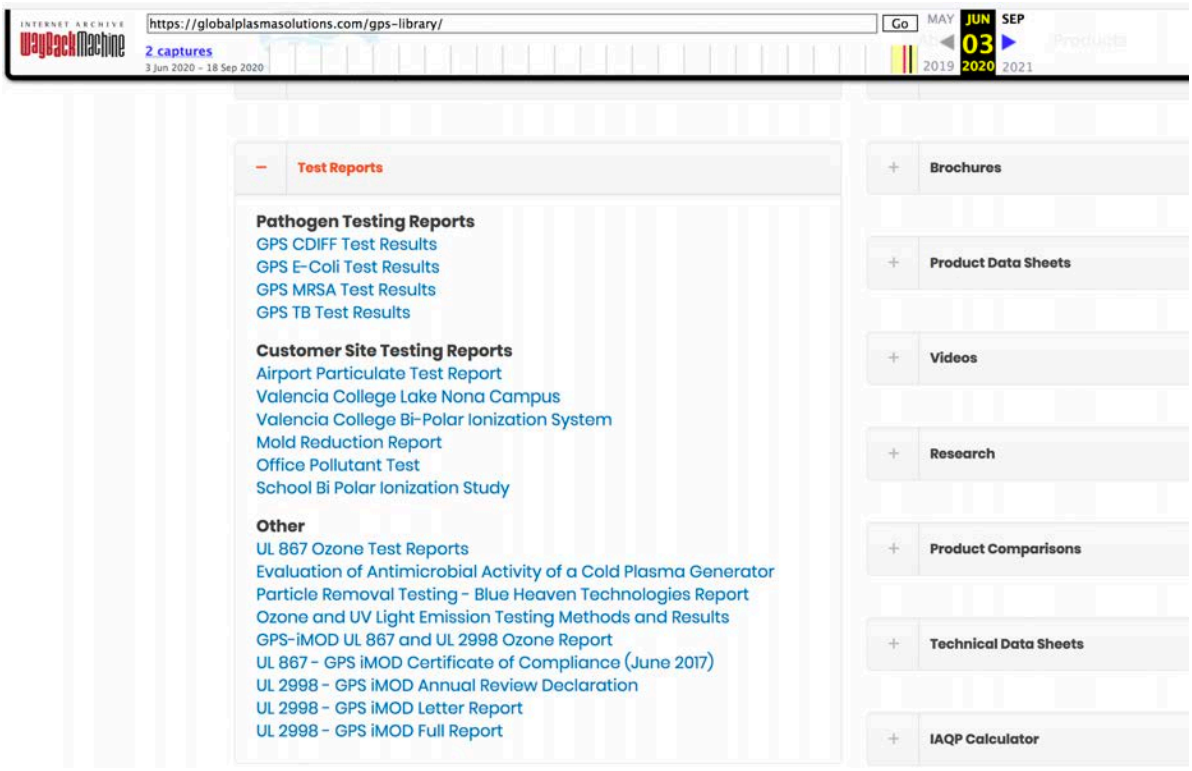
The following are the test reports listed on the GPS web page as of 10/28/20.



In addition, there are two other test reports listed on the GPS web page as of 6/13/20 (see the Way Back Machine Test Report listing below);

Particle Removal Testing – Blue Heaven Technologies Report

Evaluation of Antimicrobial Activity of Cold Plasma Generator



Let's look at these two reports first.

Particle Removal Testing

Blue Heaven Technologies

Test Chamber Particle Removal Test (modified CADR test): Comparison MERV 13 filter and MERV 8 filter + GPS

Chamber Volume: 1,000 ft^3
Particulate Tested: Environmental Tobacco Smoke (0.3 to 2.2 µm)
Particulate Instrumentation: Optical Particle Counter

Clean Air Delivery Rates (CADR) Test Results
MERV 13 filter: 271 cfm
MERV 8 filter + GPS: 20 cfm at 14 minutes and 9 cfm at 936 minutes.

These tests reveal that the GPS ionizer provides very little removal of small (i.e., 0.3 to 2.2 µm) indoor airborne particles. The AHAM recommendation for air cleaning is to use an air cleaner capable of a CADR cfm that is equal to 2/3 of the floor area (ft^2) of the

room that the air cleaner is installed. Thus, the CADRs of 9 to 20 cfm measured for the MERV 8 filter + GPS, translate into recommended room sizes of just 14 ft^2 to 30 ft^2. By contrast the MERV 13 filter tested had a CADR of 271 cfm, which translates into a 405 ft^2 room size.

Since, MERV 13 filters can be installed in most HVAC systems that can accommodate a 2 inch filter, the conclusion from the Blue Heavens Technology study is that upgrading from MERV 8 to MERV 13 provides more than ten times removal of particulates than a MERV 8 filter with GPS.

Evaluation of Antimicrobial Activity of Cold Plasma Generator

ATS Labs

Don't be fooled by this test report, which was prepared by ATS Labs (Eagan, MN).

The Evaluation of Antimicrobial Activity of Cold Plasma Generator report is a test of *Feline Calicivirus* in petri dishes with and without a GPS ionizer positioned above the surface of the petri dish for a period of 30 minutes. These tests compare the concentration of viable virus in a control sample (not exposed to GPS ionizer) and a test sample (exposed to GPS ionizer). The concentration of viable virus in the test sample was reduced by 93.5%.

A reduction of 93.5% sounds pretty good, right ? But that reduction is for a GPS ionizer positioned directly above an inoculated surface (i.e. the petri dish). How does this translate to applications of the GPS ionizers in an HVAC system for removal of airborne *Feline Calicivirus* ?

In the ATS Labs test the GPS ionizer was positioned 1 inch above petri dish of *Feline Calicivirus* for a 30-minute period. In an HVAC system the airborne *Feline Calicivirus* is moving, and only a fraction of the air in the HVAC system duct is briefly within the 1 inch distance from the ionizer (the same distance used for the petri dish tests).

Let's calculate the reduction of *Feline Calicivirus* in the air of a ventilation system using the GPS ionizer 30-minute petri dish test data and the contact time that airborne *Feline Calicivirus* has with the ionization field. For this calculation, I assumed that the ion density in the HVAC system air that is equivalent to that for the petri dish test (i.e. ionizer placed 1 inch above the petri dish), is present 1 inch directly under the 1 inch ionizer bar as well as 1 inch to the left and right of the bar for a total air duct length of 3 inches. In addition, I further assumed that this ion density extends without reduction across the full height of the air duct. These are conservative assumptions, as the actual ion density will decrease with the distance from the ionizer and will also be decreased by the airflow across the ionizer

The air speed in a typical HVAC system at the air filters and cooling coils, is 500 feet per minute. The contact time for air passing through a 3 inch length of air duct containing the GPS ionizers is just 0.0005 min (0.03 seconds). So accounting for the brief airborne exposure of *Feline Calicivirus* in an HVAC system to the GPS ionization field (0.0005

minutes for the HVAC airborne exposure and a 30 minutes for the petri dish exposure), the reduction of *Feline Calicivirus* in the air of the HVAC system is calculated to be just 0.0016%. Contact time matters.

Pathogen Testing Reports

Pathogen Testing Reports
GPS CDIFF Test Results
GPS E-Coli Test Results
GPS MRSA Test Results
GPS TB Test Results

These four test reports were all conducted by EMSL.

The GPS CDIFF Test Report is a test similar to the ATS Labs test with *Feline Calicivirus*. This EMSL test used *Clostridium difficile* bacteria in petri dishes with and without a GPS ionizer placed 5 cm (2 inches) above the surface of the petri dish for a period of 30 minutes. This test compares the concentration of viable bacteria in a control sample (not exposed to GPS ionizer) and a test sample (exposed to GPS ionizer). The concentration of viable bacteria in the test sample were reduced by 86.87%.

A reduction of 86.87% also sounds pretty good, but as with the ATS Labs test with *Feline Calicivirus*, because the contact time of the air passing through the air duct containing the GPS ionizers is so short, the reduction of airborne bacteria in the air of the HVAC system is negligible. For this calculation, I assumed that the ion density in the HVAC system air that is equivalent to that for the petri dish test (i.e. ionizer placed 2 inches above the petri dish), is also present 2 inches directly under the 1 inch ionizer bar as well as 2 inches to the left and right of the 1 inch wide bar for a total air duct length of 5 inches. For an HVAC system with an air speed of 500 feet per minute, the contact time for air passing through a 5 inch length of air duct containing the GPS ionizers is just 0.00083 min (0.05 seconds). So accounting for the brief airborne exposure of *Clostridium difficile* in an HVAC system to the GPS ionization field (0.00083 minutes for the HVAC airborne exposure and a 30 minutes for the petri dish exposure), the reduction of *Clostridium difficile* in the air of the HVAC system is calculated to be just 0.002%.

The remaining three EMSL tests, GPS E-Coli Test Results, GPS MRSA Test Results, and GPS TB Test Results, are each airborne reduction tests of viable bacteria conducted in a test chamber. The GPS TB Test Results were conducted with *mycobacterium terrae* as a surrogate for *mycobacterium tuberculosis* (TB). For each test, a solution containing the test bacteria was nebulized into the test chamber air and the concentrations of airborne bacteria were measured over a 30-60 minute test period (i.e., at 1, 5, 10, 15, 30, 60 minutes). Samples were collected onto TSA plates with an Andersen impactor, following which the plates were incubated and the resulting colonies counted. Two tests were conducted for each bacteria, one without GPS ionizers and one with two GPS ionizers operating one inch off the floor of the test chamber and on either side of a computer fan in the center of the room.

Test Chamber Airborne Bacteria Reduction Test (modified CADR test)

Chamber Volume: 280 ft^3 (the chamber air volume is not in the test report but EMSL estimated the chamber air volume to be 8 m^3, or 6.5 ft x 6.5 ft x 6.5 ft, 282 ft^3).

The following are the Clean Air Delivery Rates (CADR) for the three bacteria tests.

E-Coli: 23 cfm
MRSA: 31 cfm
M. Terrae (TB surrogate): 6 cfm

These tests show that use of two GPS ionizers in a relatively small test chamber results in very small CADRs for the three airborne bacteria tested. The AHAM recommendation for air cleaning is to use an air cleaner capable of a CADR cfm that is equal to 2/3 of the floor area (ft^2) of the room that the air cleaner is installed. Thus, the measured CADRs for these three airborne bacteria, 6 to 31 cfm, translate into recommended room sizes of just 9 ft^2 to 35 ft^2.

Customer Site Testing Reports

The following are the GPS Customer Site Testing Reports

Customer Site Testing Reports

- *Airport Particulate Test Report*
- *Valencia College Lake Nona Campus*
- *Valencia College Bipolar Ionization System*
- *Mold Reduction Report*
- *Office Pollutant Test*
- *School Bipolar Ionization Study*

These customer field reports all lack the necessary test controls for an accurate measurement of the improvement in air quality produced by the GPS ionization systems. Some studies only measured the indoor air contaminants with the GPS ionization system installed, and thus preclude any assessment of the improvement of the air quality created by the GPS system. Other studies that attempted to quantify the improvement of the air quality created by the GPS system by conducting measurements on different days with and without the GPS system operating, lacked the measurements of the outdoor air ventilation rates and indoor contaminant emission rates that are necessary to assess of the improvement of the air quality created by the GPS system.

Conclusions and Recommendations

As we all look forward to safely re-opening schools and businesses during the COVID-19 pandemic, it is important for controlling the far field airborne exposures to the SARS-CoV-2 virus that the indoor air spaces have mechanical outdoor air ventilation that at least meets the minimum code required rates, and in addition that the HVAC system have air filters with a minimum efficiency of MERV 13 (ASHRAE 52.2).

Additional removal of airborne SARS-CoV-2 virus can be achieved by installing portable air cleaners that have an AHAM certified Clean Air Delivery Rate (CADR cfm for tobacco smoke) that is equal to 2/3 of the floor area (ft^2) of the room.

WARNING !!! Only use HVAC air filters that are ASHRAE MERV rated and portable air cleaners that have an AHAM CADR rating. Do not use air filters or portable air cleaners that utilize electrostatics, ultraviolet light (UV), ozone, or photo-catalytic oxidation (PCO). Most of these devices do not have test data showing they provide any significant removal of indoor air contaminants, and some may produce harmful chemicals such as formaldehyde and ozone.

It is important to recognize that while outdoor air ventilation and air filtration can reduce the risk of far field airborne exposures to SARS-CoV-2 (e.g., greater than 6 feet), no amount of ventilation or air filtration can reduce risk of close exposure to an infected individual, only masks and social distancing can reduce this risk.