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All technical information and advice given here are based on GPS previous experiences and/or test results. GPS gives this information to the best of its knowledge but assumes no legal responsibility. Customers are asked to check the suitability and usability in the specific application, since the performance of the product can only be judged when all necessary operating data are available. The above information is subject to change.

The Case for NPBI™: It’s Safe and Effective

With the emergence of COVID-19, the role of Global Plasma Solutions’ patented needlepoint bipolar ionization (NPBI™) technology has never been more important for enhancing the safety of indoor environments. The data in this report illustrate the latest testing we have commissioned on the efficacy of NPBI technology in neutralizing the original strain of SARS-CoV-2, the virus that causes COVID-19.

SARS-CoV-2 is most frequently transmitted by air. However, the potential for surface transmission also exists. For this reason, GPS secured both in-air and surface testing for this report. In addition, testing was conducted at different ion levels to understand results in a range of settings. Furthermore, tests were conducted with different levels of ionization over time. Assuming that higher ionization levels and longer time intervals would, in all likelihood, result in greater pathogen reduction, we sought to determine safe, effective, realistic measures for ionization and duration.

Of special importance is the fact that GPS reports the net rate of pathogen reduction. Whereas gross rates of reduction would appear more effective, net rates are more meaningful, showing effectiveness when compared with a control.

The scientific validity of data we report is fundamental to our mission at GPS. Be assured, we are committed to continuously striving for best-in-class, independent performance validation and technology research. Because of the risks inherent in testing SARS-CoV-2, all tests in this report were conducted in a BSL-3 lab.

We are also committed to ensuring our testing methodology is relevant to real-world environments. In the current case, a large chamber was used to approximate an office space. Ionized air was introduced in a similar way to how a typical HVAC system would deliver ions in an actual room. This conservative approach is more representative of actual use conditions for ionization, relative to introducing high concentrations of ions directly onto pathogen samples.

The use of a control environment in this research was crucial to assessing pathogen reduction using NPBI technology. As the world endeavors to safeguard building occupants from COVID-19, the disparity between utilizing NPBI technology and taking no measures in managing the SARS-CoV-2 pathogen is noteworthy.

As you will see in the studies’ conclusions, NPBI is highly effective in neutralizing the SARS-CoV-2 pathogen. We welcome your interest in utilizing NPBI technology for pathogen reduction.

For additional information, please contact your GPS representative.

Sincerely,

Edward A. Sobek, Ph.D.
Chief Science Officer
Research Summary

CONCLUSION
In an environment employing GPS® NPBI™ technology, active virus in the air was reduced after 15 minutes of exposure in aerosol form, and collectable virus in the air was significantly reduced over the course of 60 minutes. By contrast, the control test, which lacked ionization technology, resulted in much higher measurements of the virus. NPBI reduction results were achieved without reliance on or production of potentially harmful ozone.

TESTING OBJECTIVE
To determine the efficacy of NPBI technology on airborne SARS-CoV-2 virus, this testing measured what reductions in virus level were possible under controlled conditions after the pathogen was introduced into a testing chamber via aerosolization. The testing measured relative rates of pathogen reduction as exposure to ions increased and as time elapsed.

METHODOLOGY
A BSL-3-rated bio safety testing chamber with a controlled air source closely replicated real-life applications while controlling for variables such as air velocity, temperature and humidity. A single, centrally positioned bioaerosol nebulizing port dispersed SARS-CoV-2 pathogen into the air. Positive and negative ions were introduced via a custom HVAC unit designed to mimic units typically used in commercial applications, upfitted with GPS FC48 NPBI technology. Fans in each corner of the chamber for airflow ensured that ions mixed with the airborne virus. Four air sample ports throughout the room were connected to programmable vacuum devices and contained internal filtration discs to collect viral samples and measure the pathogen in the air. Effects were measured for varying durations. For control purposes, the same tests were conducted without the utilization of GPS NPBI technology.

DISCLAIMER: Please note that testing the reduction rate of SARS-CoV-2 with the GPS NPBI product is an evolving process and additional testing is anticipated to be conducted in the future.
The test stage can be seen in the design diagram and consisted of a metal and laminate safety test chamber measuring 20' w x 8' h x 8' d with sealed seams.

Temperature during all test runs was approximately 72 +/- 2f with a relative humidity of 47%.

The aerosol particles containing the virus that was nebulized into the air averaged 0.8 micrometers in diameter.

At a concentration of 18,000 negative ions, airborne virus was reduced by **98.33% in 60 minutes**.

*Represents net rate of reduction. At the same concentration of negative ions, the gross rate of reduction was 99.70% in 60 minutes.
The graphs below illustrate the rate of net pathogen reduction across various ion densities.

Remaining active airborne SARS-CoV-2 virus in BSL3 room after 60 minutes with ionizer off versus on.

Remaining active airborne SARS-CoV-2 virus in BSL3 room after 60 minutes with ionizer off versus on.
CONCLUSION
Pathogens tested in an environment employing GPS® NPBI™ technology were neutralized much more rapidly when compared with the control, which lacked ionization technology. As exposure time to ionization increased, pathogen neutralization also increased for both ion concentration target levels tested.

TESTING OBJECTIVE
To ascertain the efficacy of GPS NPBI technology for neutralizing the SARS-CoV-2 pathogen on surfaces, this testing measured relative levels of pathogen inactivity as exposure to ions increased and as time elapsed.

METHODOLOGY
A BSL-3-rated bio safety testing chamber with a controlled air source closely replicated real-life applications while controlling for variables such as air velocity, temperature and humidity. Known quantities of the SARS-CoV-2 pathogen on glass slides were exposed to both positive and negative ions, with targeted levels of negative ions at 10,000 ions/cc and 20,000 ions/cc. Ions were introduced to the chamber via a custom HVAC unit designed to mimic units typically used in commercial applications, upfitted with GPS NPBI technology. Effects were measured for varying durations. For control purposes, the same tests were conducted without the utilization of GPS NPBI technology.

DISCLAIMER: Please note that testing the reduction rate of SARS-CoV-2 with the 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.
The test stage can be seen in the design diagram and consisted of a metal and laminate safety test chamber measuring 20' w x 8' h x 8' d with sealed seams.

Temperature during all test runs was approximately 71 +/- 2°F with a relative humidity of 52%.

At a concentration of 23,600 negative ions, 
pathogen activity was reduced by 99.98% in 60 minutes.

*Represents net rate of reduction. At the same concentration of negative ions, the gross rate of reduction was 99.99% in 60 minutes.
The graphs below illustrate the rate of net pathogen reduction across various ion densities.

Remaining active surface SARS-CoV-2 virus in BSL3 room after 60 minutes with ionizer off versus on.

Remaining active surface SARS-CoV-2 virus in BSL3 room after 60 minutes with ionizer off versus on.
The graphs below illustrate the rate of net pathogen reduction across various ion densities.

Remaining active surface SARS-CoV-2 virus in BSL3 room after 60 minutes with ionizer off versus on.

**SARS-CoV-2 Neutralization at an avg. of 20,600 neg. ions/cm³**

<table>
<thead>
<tr>
<th>Exposure Time</th>
<th>Control</th>
<th>Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Minute</td>
<td>7.00E+06</td>
<td>5.81E+06</td>
</tr>
<tr>
<td>5 Minute</td>
<td>6.00E+06</td>
<td>5.48E+06</td>
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<tr>
<td>10 Minute</td>
<td>5.00E+06</td>
<td>5.31E+06</td>
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<tr>
<td>15 Minute</td>
<td>4.00E+06</td>
<td>5.09E+06</td>
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<td>30 Minute</td>
<td>3.00E+06</td>
<td>4.74E+06</td>
</tr>
<tr>
<td>60 Minute</td>
<td>2.00E+06</td>
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Remaining active surface SARS-CoV-2 virus in BSL3 room after 60 minutes with ionizer off versus on.

**SARS-CoV-2 Neutralization at an avg. of 23,600 neg. ions/cm³**

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