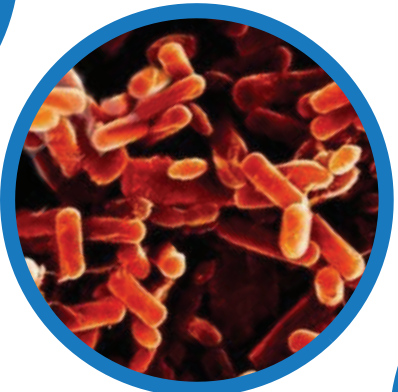
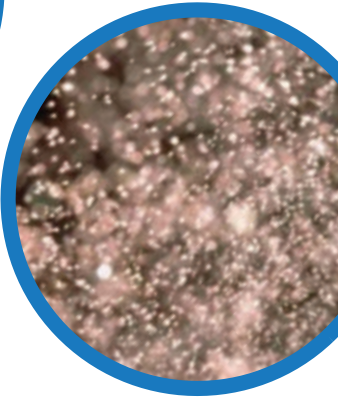


**SES**  SANITATION  
 ENGINEERING  
 SYSTEMS

**PUREAIR**  
series



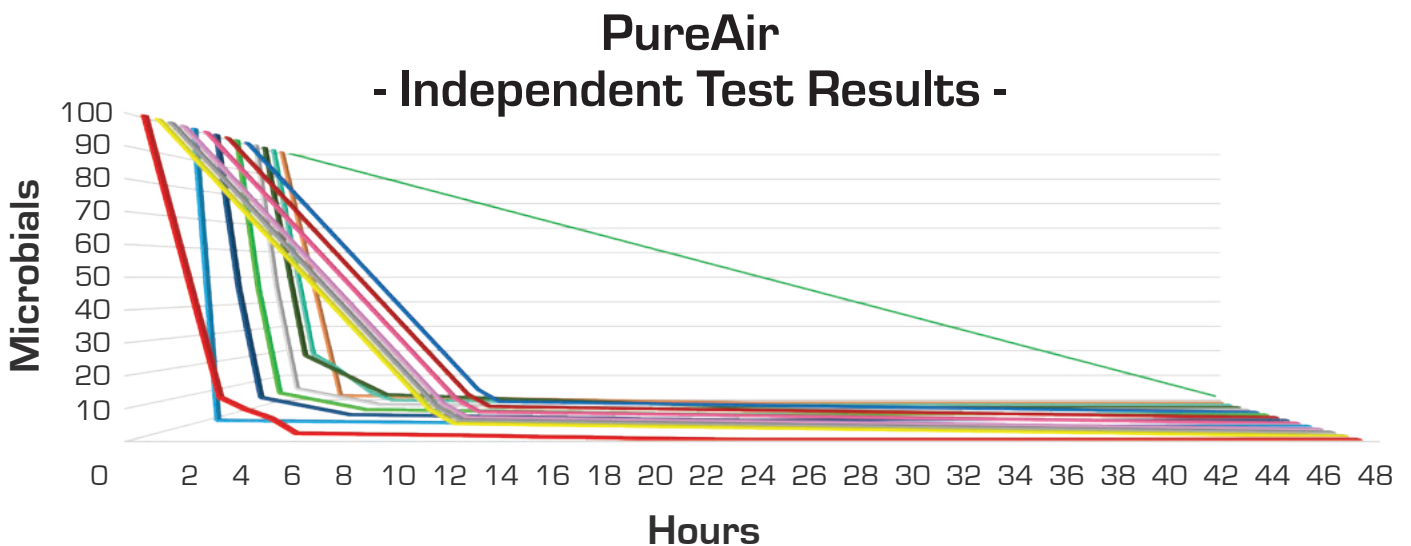
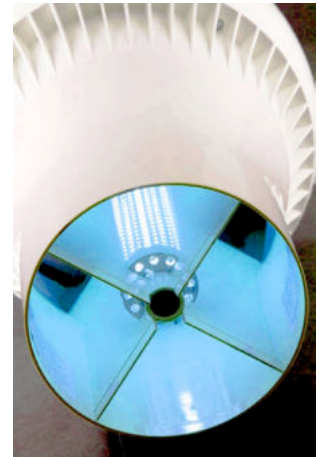
**SUPPORTING TEST DATA**  
Air Purification, Infection & Odour Control System

# Supporting Test Data

## PureAir - Air Purification & Odour Control System PHI (Photohydroionization) Advanced Oxidisation Technology

Summary of university & independent lab tests:

- 4-log reduction (99.99%) surface bacteria / virus reduction
- 99% reductions of E. coli, Listeria, Staph, SARS and MRSA
- 99% odour reduction
- 99% food surface microbial reduction
- 98% mould reduction
- 97% airborne bacteria / virus reduction
- Over 80% reduction of gases, vapours and VOCs
- 99% of microbes in sneeze killed within 3 feet
- Major city schools reports 20% reduction in absenteeism
- Tested & approved by the Chinese Government for protection against the SARS Virus
- Military approved for mould protection in field hospitals
- Hospital approvals Infectious Diseases - U.S. & International 99% reduction of Staph (MRSA)
- Approved by the USDA, FSIS and FDA for use in food processing plants
- Fox News indoor air series featured PHI & concluded substantial mould & bacteria reductions
- PHI technology has been featured on Fox, ABC, CBS & in Popular Science Magazine



■ **MRSA**  
- 99.99% reduction in 24 hours

■ **NORWALK VIRUS**  
- 99.99% reduction in 24 hours

■ **BIRD & SWINE FLU**  
- 99.99% reduction in 24 hours

■ **PSEUDOMONAS SP.**  
- 99.99% reduction in 24 hours

■ **BACILLUS SPP.**  
- 99.99% reduction in 24 hours

■ **CANDIDA ALBICANS**  
- 99.99% reduction in 24 hours

■ **E. COLI**  
- 99.99% reduction in 48 hours

■ **STREPTOCOCCUS PNEUMONIAE**  
- 99.99% reduction in 48 hours

■ **STAPHYLOCOCCUS AUREUS**  
- 99.99% reduction in 48 hours

■ **LISTERIA**  
- 99.99% reduction in 48 hours

■ **STACHYBOTRYIS CHARTARUM**  
- 99.99% reduction in 48 hours

■ **BACILLIUS GLOBIGII**  
- 99.99% reduction in 48 hours

■ **SARS**  
- 99%+ reduction in 24 hours

■ **MOULD**  
- 98% reduction in 48 hours

■ **STREPTOCOCCUS SP.**  
- 96% reduction in 24 hours



PHI Advanced Oxidation Technology was first developed over 20 years ago. Over 1 million PHI Cells are in use around the world. PHI technology has been licensed to many Fortune 500 companies for use in the medical, food, military, residential, commercial, marine, hospitality and government, etc. PHI cells in various products have been tested and/or approved or registered by:

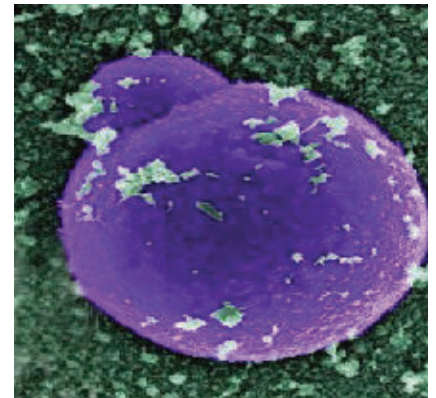
- European Union
- U.S. Government – GSA
- USDA & FSIS· UL, ETL, TUV, EU,
- EPA & CSA
- U.S. Military
- Electric Power Research Institute
- Chinese Government
- Japanese Government (TV commercials)
- Canadian Government

In addition, PHI cells have been specified in the Norovirus & MRSA protection plan of America’s largest restaurant chains, hotel chains, theme parks, cruise lines, public schools and hospitals. The following is a summary of some of the testing and studies performed by third party independent labs and universities. PHI products are not medical devices and no medical claims are made.

## **MRSA - Methicillin Resistant Staphylococcus Aureus**

Methicillin-resistant Staphylococcus aureus (MRSA) is a type of bacteria that is resistant to certain antibiotics. These antibiotics include methicillin and other more common antibiotics such as oxacillin, penicillin and amoxicillin. Staph infections, including MRSA, occur most frequently among persons in hospitals and healthcare facilities (such as nursing homes and dialysis centers) who have weakened immune systems.

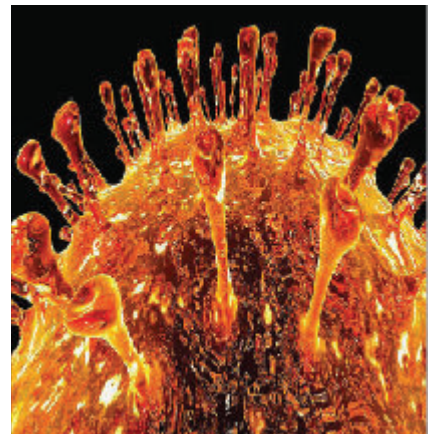
Source: CDC (Center for Disease Control & Prevention)  
 Tested by Kansas State University **Inactivation Rate 99+%**



## **H1N1 (Swine Flu)**

Kansas State University has completed preliminary testing on Photohydroionization (PHI-Cell®) technologies with **99+% inactivation of H1N1 Swine Flu on a stainless steel surface**. Further tests are scheduled. 2009 H1N1 (referred to as “swine flu” early on) is a new influenza virus causing illness in people. This new virus was first detected in people in the United States in April 2009. This virus is spreading from person-to-person worldwide. On June 11, 2009, the World Health Organization (WHO) signaled that a pandemic of 2009 H1N1 flu was underway. Spread of 2009 H1N1 virus is thought to occur in the same way that seasonal flu spreads. Flu viruses are spread mainly from person to person through coughing or sneezing by people with influenza. Sometimes people may become infected by touching items – such as a surface or object – with flu viruses on it and then touching their mouth or nose.

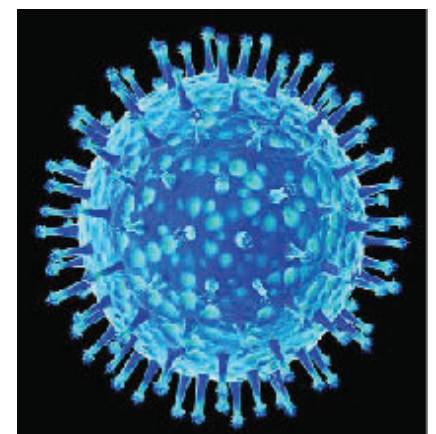
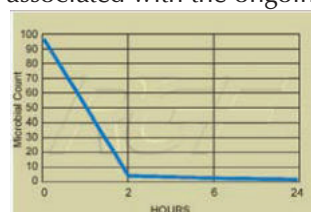
Tested by Kansas State University **Inactivation Rate 99+%**



## **Avian influenza (Bird Flu)**

Avian influenza is an infection caused by avian (bird) influenza (flu) viruses. These influenza viruses occur naturally among birds. Wild birds worldwide carry the viruses in their intestines, but usually do not die from them. However, avian influenza is very contagious among birds and can make some domestic birds, including chickens, ducks and turkeys, very sick and kill them. Of the few avian influenza viruses that have crossed the species barrier to infect humans, H5N1 has had the largest number of detected cases of severe disease and death in humans. Of the human cases associated with the ongoing H5N1 outbreaks in poultry and wild birds in Asia, Europe, the Near East and Africa, more than half of those people reported infected with the virus died. While there has been some human-to-human spread in H5N1, it has been limited, inefficient and unsustainable.

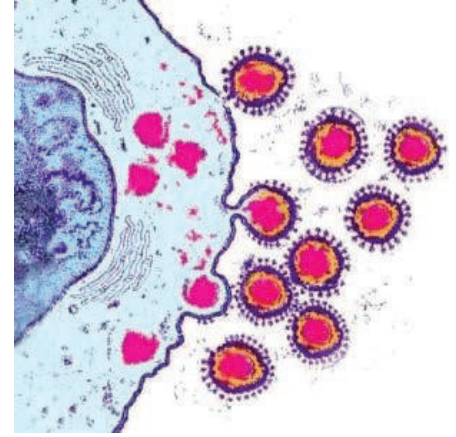
Source: CDC (Center for Disease Control & Prevention)  
 Tested by Kansas State University **Inactivation Rate 99+%**



## SARS

Severe acute respiratory syndrome (SARS) is a viral respiratory illness caused by a coronavirus, called SARS-associated coronavirus (SARS-CoV). SARS was first reported in Asia in February 2003. Over the next few months the illness spread to more than two dozen countries in North America, South America, Europe, and Asia before the SARS global outbreak of 2003 was contained. The main way SARS seems to spread is by close person-to-person contact. The disease can spread when droplets from the cough or sneeze of an infected person are propelled a short distance (generally up to 3 feet) through the air. The virus also can spread when a person touches a surface or object contaminated with the infectious droplets and then touches his or her mouth, nose or eye(s).

Source: CDC-Centers for Disease Control and Prevention  
Tested by NEI-Chinese Government **Inactivation Rate 99+%**



## Listeria

This is a Gram-positive bacterium, motile by means of flagella. Some studies suggest that 1-10% of humans may be intestinal carriers of *L. monocytogenes*. It has been found in at least 37 mammalian species, both domestic and feral, as well as at least 17 species of birds and possibly some species of fish and shellfish. The manifestations of listeriosis include septicemia, meningitis (or meningoencephalitis), encephalitis, and intrauterine or cervical infections in pregnant women, which may result in spontaneous abortion or stillbirth.

Source: U.S. Food and Drug Administration  
Tested by: Kansas State University  
Steris Labs  
KAG / Eco Labs

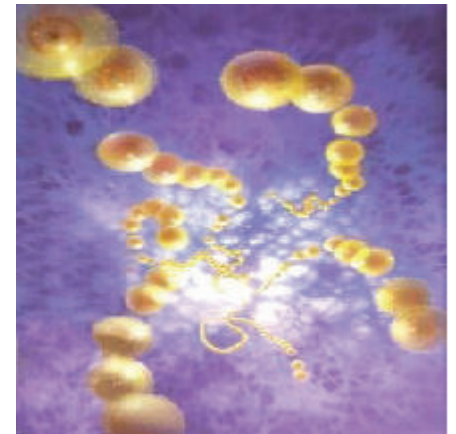
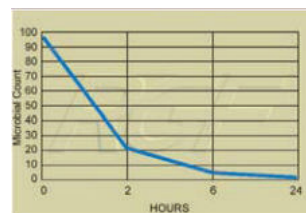
**Inactivation Rate 99+%**



## Streptococcus Sp.

Group A Streptococcal (strep) infections are caused by group A streptococcus, a bacterium responsible for a variety of health problems. These infections can range from mild skin infection or sore throat to severe, life-threatening conditions such as toxic shock syndrome and necrotizing fasciitis, commonly known as flesh eating disease. Health experts estimate that more than 10 million mild infections (throat and skin) like these occur every year. Secondary infections include: Rheumatic Fever, Impetigo, Cellulites, Erysipelas and Scarlet Fever.

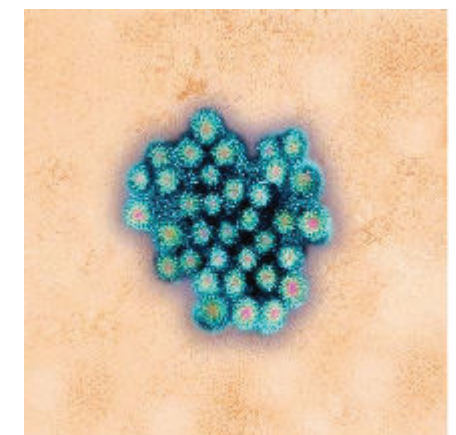
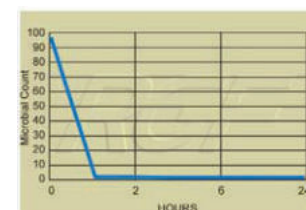
Source: U.S. Department Of Health & Human Control Services  
Tested by Kansas State University **Inactivation Rate 96+%**



## Norwalk Virus

Noroviruses are a group of related, single-stranded RNA, non-enveloped viruses that cause acute gastroenteritis in humans. Noroviruses are named after the original strain "Norwalk virus," which caused an outbreak of gastroenteritis in a school in Norwalk, Ohio, in 1968. No evidence suggests that infection occurs through the respiratory system. Noroviruses are highly contagious and as few as 10 viral particles may be sufficient to infect an individual. During outbreaks of norovirus, several modes of transmission have been documented; for example, initial food-borne transmission in a restaurant, followed by secondary person-to-person transmission to household contacts. 50% of all food-borne outbreaks of gastroenteritis can be attributed to noroviruses. Among the 232 outbreaks of norovirus illness reported to CDC from 1997 to 2000 36% were in restaurants, 23% were in nursing homes, 13% were in schools and 10% were vacation settings or cruise ships.

Source: CDC (Center for Disease Control & Prevention)  
Tested by Midwest Research Institute **Inactivation Rate 99+%**

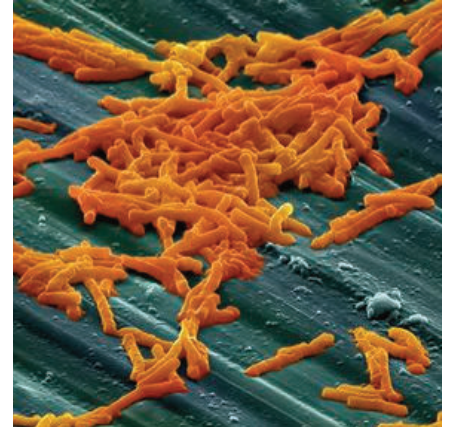
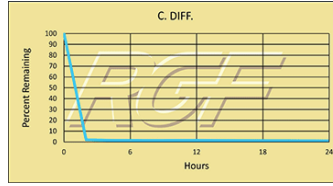




## Clostridium Difficile (C-Diff)

Many hospitals have been waiting for more information on C-Diff bacteria as it may be as big a problem or bigger than MRSA. Clostridium difficile, also known as C-diff or C. difficile, is a gram-positive bacterium that can cause an inflammation known as colitis. It is considered a healthcare-associated infection (HAI), which is an infection that patients get while receiving treatment for medical or surgical conditions. C-Diff infection rates have been on the rise and are becoming more severe and difficult to treat. Independent university studies produced a 99%+ kill rate.

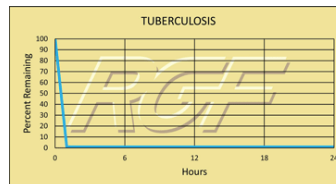
Source: CDC-Centers for Disease Control and Prevention  
Tested by Kansas State University **Inactivation Rate 99+%**



## Tuberculosis

Tuberculosis is caused by the bacterium Mycobacterium tuberculosis. It typically attacks the lungs, but can also affect other parts of the body. It is spread through the air when people with infection cough, sneeze, or otherwise transmit their saliva through the air. Most infections are asymptomatic and latent, but about one in ten latent infections eventually progresses to active disease which, if left untreated, kills more than 50% of those so infected.

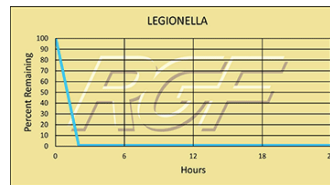
Source: Health and Industry / CDC Center for Disease Control  
Tested by Kansas State University **Inactivation Rate 99+%**



## Legionella

Legionella is a group of pathogenic bacteria that is one of the most frequent causes of waterborne disease in humans. They are found naturally in the environment, and grow best in warm water. One type of pneumonia caused by Legionella is called legionellosis, or commonly known as Legionnaires' disease. The disease is transmitted when people breathe in a mist or vapor with the bacteria. However, they do not spread from one person to another person.

Source: CDC Centers for Disease Control  
Tested by Kansas State University **Inactivation Rate 99+%**



## Escherichia Coli

Escherichia coli, usually abbreviated to E. coli, discovered by Theodor Escherich, a German pediatrician and bacteriologist, is one of the main species of bacteria that live in the lower intestines of mammals, known as gut flora. The number of individual E. coli bacteria in the feces that a human excretes in one day averages between 500 billion and 10 trillion. All the different kinds of fecal coli bacteria, and all the very similar bacteria that live in the ground are grouped together under the name coliform bacteria. E. coli can be the causative agent of several intestinal and extra-intestinal infections such as urinary tract infections, meningitis, peritonitis, mastitis, septicemia and gram-negative pneumonia.

Source: CDC (Center for Disease Control & Prevention)  
Tested by Kansas State University **Inactivation Rate 99+%**



## Pseudomonas Sp.

The bacterial genus *Pseudomonas* includes plant pathogenic bacteria such as *P. syringae*, the opportunistic human pathogen *P. aeruginosa*, the ubiquitous soil bacterium *P. putida*, and some species that are known to cause spoilage of unpasteurised milk and other dairy products. The Pseudomonads are metabolically diverse, can consequently colonize a wide range of niches, and are generally perceived to be agents of spoilage and degradation.

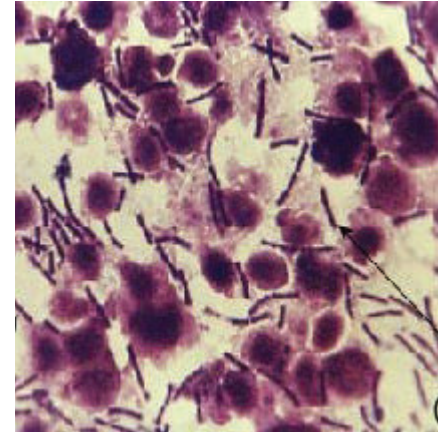
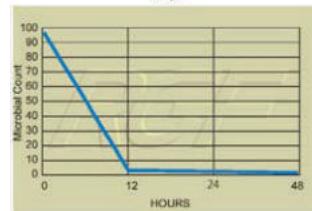
Source: CDC (Center for Disease Control & Prevention)  
Tested by Kansas State University **Inactivation Rate 99+%**



## Bacillus Globigii

*Bacillus globigii* lives in soils around the world and can readily be found in samplings of wind-borne dust particles. It is also known as *Bacillus subtilis*, its more modern name. The National Institutes of Health's Centers for Disease Control lists BG as a "Class 1" organism, meaning it is harmless and non-pathogenic to humans. It can be purchased commercially and has been used for decades in biological studies. *B. globigii* has the ability to form a tough, protective endospore, allowing the organism to tolerate extreme environmental conditions, making it a perfect surrogate for testing systems and procedures against *Bacillus anthracis*. *B. globigii* is also often used as the Gram-positive equivalent of *Escherichia coli*, an extensively studied Gram-negative rod.

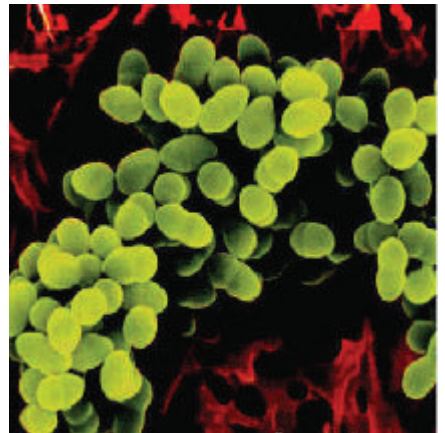
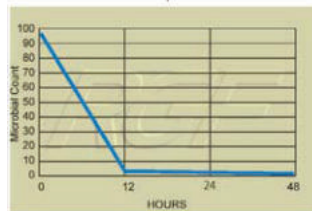
Source: CDC (Center for Disease Control & Prevention) & Los Alamos National Laboratory  
Tested by Kansas State University **Inactivation Rate 99+%**



## Staphylococcus Aureus

*Staphylococcus aureus*, often referred to simply as "staph," is a bacteria commonly found on the skin and in the nose of people. Person-to-person transmission is the usual form of spread and occurs through contact with secretions from infected skin lesions, nasal discharge or spread via the hands. *S. aureus* is a spherical bacterium (coccus) which on microscopic examination appears in pairs, short chains, or bunched, grape-like clusters. These organisms are Gram-positive. Some strains are capable of producing a highly heat-stable protein toxin that causes illness in humans. Some isolates of *S. aureus* are classified as Methicillin-resistant *Staphylococcus aureus* (MRSA). These are a type of bacteria that are resistant to certain antibiotics. These antibiotics include methicillin and other more common antibiotics such as oxacillin, penicillin and amoxicillin. Staph infections, including MRSA, occur most frequently among persons in hospitals and healthcare facilities (such as nursing homes and dialysis centers) who have weakened immune systems.

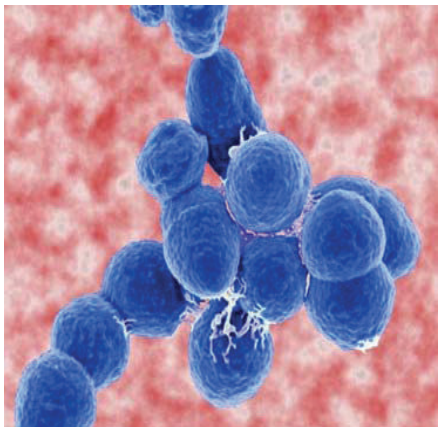
Source: CDC (Center for Disease Control & Prevention) & FDA (Food and Drug Administration)  
Tested by Kansas State University **Inactivation Rate 99+%**



## Streptococcus Pneumoniae

*S. pneumoniae* is an exclusively human pathogen and is spread from person-to-person by respiratory droplets, meaning that transmission generally occurs during coughing or sneezing to others within 6 feet of the carrier. Thus, carriers of *S. pneumoniae*, while generally healthy, are an important source of infection and disease for others. The most common types of infections caused by this bacteria include middle ear infections, pneumonia, blood stream infections (bacteremia), sinus infections, and meningitis. In the 1940s, penicillin antibiotics became available and were used effectively to treat pneumococcal infections. During the 1960s, however, the first pneumococcal bacteria that were not susceptible ("resistant") to penicillin were discovered in humans. Since then, penicillin resistant pneumococcal bacteria have been reported all over the world.

Tested by Kansas State University **Inactivation Rate 99+%**

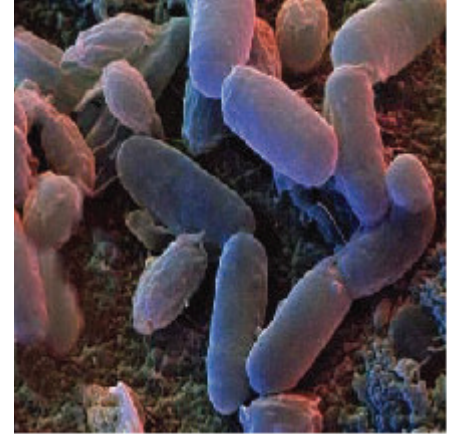




## Bacillus Spp.

*Bacillus cereus* is a Gram-positive, facultatively aerobic sporeformer whose cells are large rods and whose spores do not swell the sporangium. These and other characteristics, including biochemical features, are used to differentiate and confirm the presence of *B. cereus*, although these characteristics are shared with *B. cereus* var. *mycoides*, *B. thuringiensis* and *B. anthracis*. *B. cereus* food poisoning is the general description, although two recognized types of illness are caused by two distinct metabolites. All people are believed to be susceptible to *B. cereus* food poisoning.

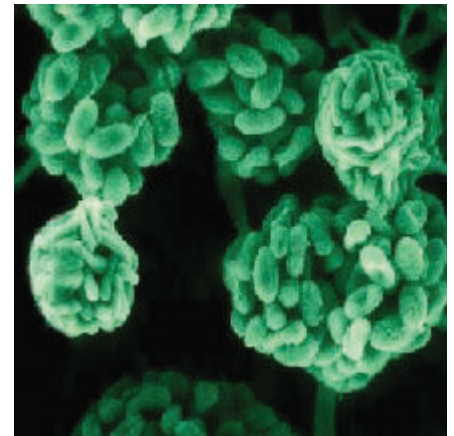
Source: U.S. Food and Drug Administration  
Tested by Kansas State University Inactivation Rate 99+%



## Stachybotrys Chartarum

*Stachybotrys* is a greenish-black fungus found worldwide that colonizes particularly well in high-cellular material, such as straw, hay, paper, dust, lint, and cellulose containing building materials such as fiber board and gypsum board that become chronically moist or water damaged due to excessive humidity, water leaks, condensation or flooding. *Stachybotrys chartarum* grows and produces spores in the temperature range of 36-104F. It is also capable of producing several toxins however, researchers still know little about the temperature and moisture conditions under which these toxins are produced.

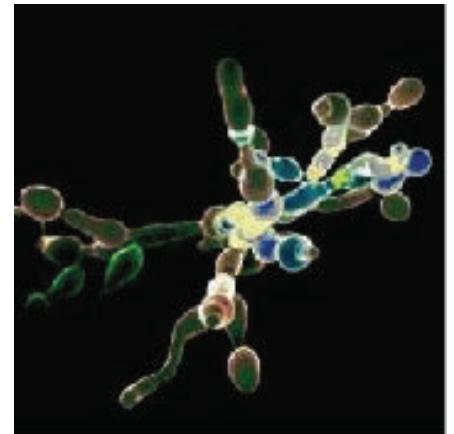
Source: Health and Industry  
Tested by Kansas State University **Inactivation Rate 99+%**



## Candida Albicans

*Candida albicans* is a diploid sexual fungus (a form of yeast), and a causal agent of opportunistic oral and vaginal infections in humans. Systemic fungal infections have emerged as important causes of morbidity and mortality in immunocompromised patients (e.g., AIDS, cancer chemotherapy, organ or bone marrow transplantation). In addition, hospital-related infections in patients not previously considered at risk (e.g. patients on an intensive care unit) have become a cause of major health concern.

Source: CDC (Center for Disease Control & Prevention)  
Tested by Kansas State University **Inactivation Rate 99+%**



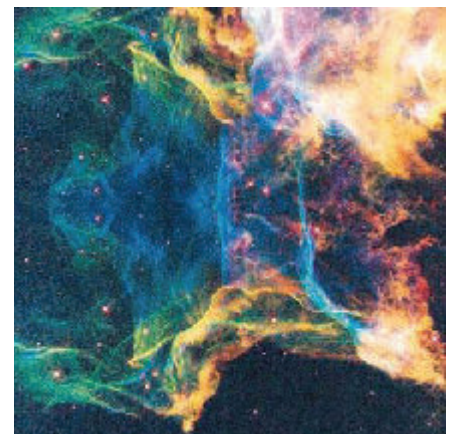
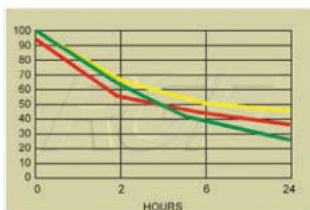
## Odours

The purpose of this test was to evaluate to what effect the PHI unit has on cleaning chemicals, pet odours and perfume odours. This test was performed utilizing two 500 cubic foot test chambers and a ten-person odour panel. The qualitative assessments of the ten-person odour panel were then used as a means to determine the odour reduction.

Tested by C&W Engineering (Independent PE Firm)

Reduction %

- Cleaning chemicals 55+%
- Pet odours 72%
- Perfume odours 63+%



## Chemical Odours (VOCs)

The purpose of this test was to evaluate the effect the PHI unit has on chemical odours.

Tests were conducted by GC/MS

Tested by NELAP Accredited Independent Lab

Reduction %

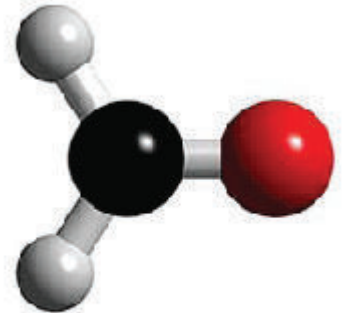
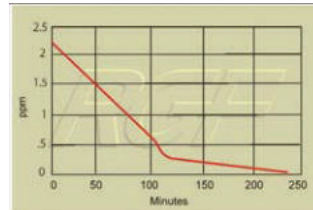
- Toluene 29%
- D-limonene 98%
- Methyl Ethyl Ketone 13%



## Formaldehyde

The purpose of this test was to evaluate the effect the PHI unit has on formaldehyde.

Tests were conducted in test chamber by Kansas State University



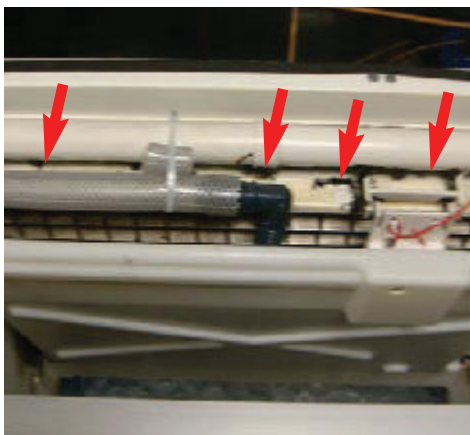
The purpose of this test was to evaluate the effect the PHI unit has on formaldehyde in a home.

Tests were conducted in actual mobile homes for FEMA.

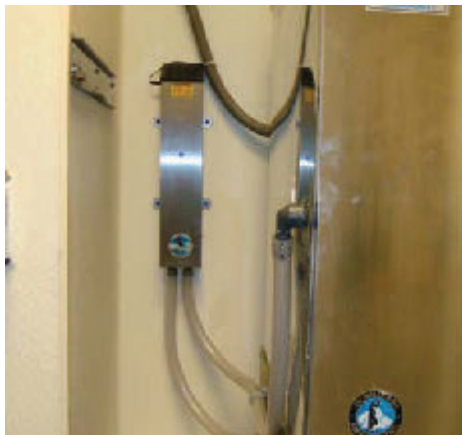


## Subway Corp. Ice Machine Test

The purpose of this test was to evaluate the effect the PHI unit has on ice machines used in Subway Sandwich stores. Tests were conducted in actual store.



Before testing and cleaning visible microbial growth.



Clean Ice Machine start of testing at Subway Corp.



3 months later using PHI ice units no visible microbial growth.



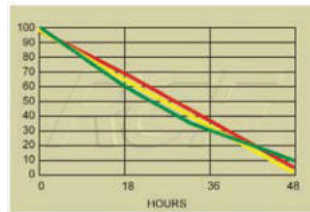
## Mold/Yeast

The purpose of this test was to evaluate the effect the PHI unit has on mold/yeast bacteria (TPC). This test was performed utilizing a standard 2000 sq. ft. home and 3000 sq. ft. simulated home.

Tested by: *California Microbiology Center  
Independent Accredited Lab - IBR  
Kansas State University  
University of Florida  
United States Air Force  
R&D Labs  
C&W Engineering  
University of Cincinnati  
Kane Regional Hospital*

Reduction %

- Bacteria 99%
- Mold 97- 98%
- Yeast 90+%



## Chemical Compounds

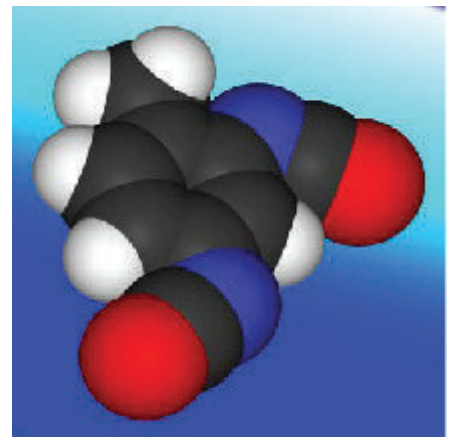
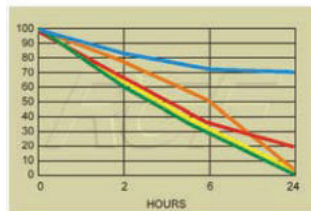
Gas Chromatograph/Mass Spectrometer test performed by Nelap Accredited Lab on airborne chemical compound reduction using PHI AOT (Advanced Oxidization Technology).

Hydrogen Sulfide - Rotten eggs  
Methyl mercaptan - Rotten cabbage  
Carbon Disulfide - Vegetable sulfide  
Butyl Acetate - Sweet banana  
Methyl Methacrylate - Plastic

Tested by *GC/MS Nelap Accredited Independent Lab*

Reduction %

- Hydrogen Sulfide 80%
- Methyl mercaptan 100%
- Carbon Disulfide 30%
- Butyl Acetate 100%
- Methyl Methacrylate 100%



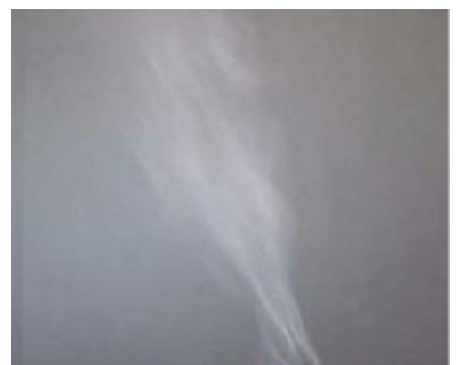
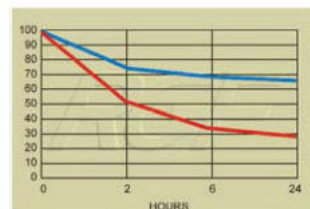
## Smoke (Odours and Particulates)

The purpose of this test was to evaluate to what effect the PHI unit has on cigarette smoke odours and particulate. This test was performed utilizing two 500 cubic foot test chambers and a ten-person odour panel. The qualitative assessments of the ten-person odour panel were then used as a means to determine the odour reduction. Particulate was tested with a laser particle counter.

Tested by *C&W Engineering (Independent PE Firm)*

Reduction %

- Smoke odours 70%
- Smoke particulate 25%



## Food Safety

PHI Advanced Oxidization Technology has been approved by the USDA and FDA in 2001 for use in food processing facilities worldwide. Since the approval PHI AOT equipment has been incorporated in every aspect of food processing; meat, poultry, fish, grain, fruit, vegetables, processed meats, ready to eat and restaurants.

Tested and approved for use in plants by *USDA, FDA and FSIS.*

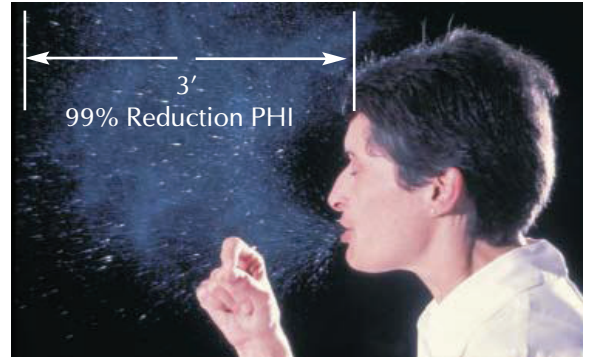
Tested for safe reduction of airborne and surface bacteria, mold, virus and yeast in food processing plants.



## Sneeze Test

A testing protocol concept was used which included a "Sneeze Simulation Machine" and "Sneeze" chamber. A sneeze can travel at up to 100 mph, so we had to consider lung capacity, sneeze pressure and liquid volume to properly simulate a human sneeze. This was accomplished and the test proceeded with outstanding results. An average of 99% reduction of microbials was achieved with PHI in a double blind test, at 3 feet from the sneeze source. This is clearly not a medically supervised test or protocol. However, from a practical point, it was definitely providing some kill at the source and will provide some level of protection.

*Simulated Sneeze Lab Test at three feet in a 250 cu ft Bio Test Chamber.  
An independent PE double blind study - **Microbe Inactivation Rate 99+%***



## Electrical

All PHI devices have been thoroughly tested for electrical safety in house, by consultants and certified independent agencies. Results were excellent.

*Tested by: TUV, ETL, UL, NEI China, RGF Labs. The Japanese Government, GSA, Electrical Power Research Institute.*

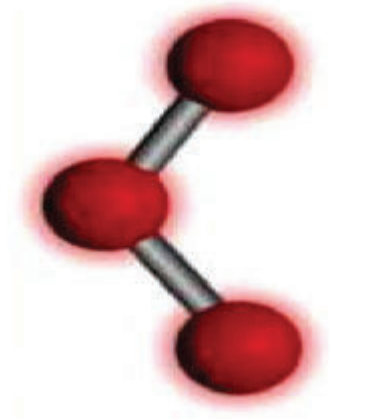


## Ozone / EMF

PHI devices have been thoroughly tested for ozone / emf - Electro Magnetic Frequency and have passed Federal Safety Standards.

*Tested by: FSIS Federal Safety Inspection Services  
UL, ETL, TUV, CSA  
ISSES / Disney*

Note: Many household appliances emit some ozone and emf in safe low levels such as fluorescent lights, motors, computers, copy machines, refrigerators, blenders, electronic air filters, air conditioners, electric fans, microwave ovens etc.



## Effective Coverage (Area Test)

A 3000 square foot simulated house was constructed inside a windowless warehouse. The simulated house was constructed of virgin poly and was completely emptied and then sanitized. A PHI cell was placed in the center of the mock home to determine the effective area of coverage for a single cell. Results were obtained showing AOP (Advanced Oxidation Process) levels of .01-.02 ppm in each room (results will vary with virus, bacteria, organic, VOC and odour loading). It is highly unlikely a cell will ever be used in a completely empty, sanitized and organic (load) free room. This test was to demonstrate theoretical coverage. In practice, one cell will effectively cover 2,000 square feet of an average home.

*Tested by: RGF Labs, verified by independent P.E.*





## TESTING AGENCIES & ACCREDITATIONS



## SAFETY

It is a normal reaction to question the long term safety of any product that is effective and uses new or "breakthrough" technology. This type of question has become common as our litigious society has taught us to question things that significantly outperform existing methods or products.

The PHI advanced oxidation technology that produced the results found on the pages of this report certainly fall into the category of breakthrough technology. This is evident by its outstanding test results across the entire range of microbes.

The breakthrough in the PHI advanced oxidation technology is not found in the final product (hydroperoxides) but rather in the method by which they are produced. The active ingredient created by the PHI unit is a group of oxidants known as Hydroperoxides. Hydroperoxides have been a common part of our environment for over 3.5 billion years. Hydroperoxides are created in our atmosphere whenever three components are present: unstable oxygen molecules, water vapor and energy (electro magnetic).

Hydroperoxides are very effective (as demonstrated by the test results in this book) at destroying harmful microbials. As oxidants, they do this by either destroying the microbe through a process known as cell lysing or by changing its molecular structure and rendering it harmless (which is the case in VOC's and odours). The amount of hydroperoxides required to accomplish this task in a conditioned space is well below the level that is constantly in our outside air. The advanced oxidation technology found in the PHI has brought the oxidants found in the outside air into the conditioned space.

There is no known case of hydroperoxides ever creating a health risk. Considering we have been exposed to hydroperoxides in nature since the day man stepped on the planet, it is a reasonable assumption that hydroperoxides do not constitute a health risk.

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### **Disclaimer:**

All the above tests were performed on the PHI Advanced Oxidation product with Advanced Oxidation Plasma of less than .02 ppm. They were conducted by independent accredited labs and university studies. They were funded and conducted by major clients to assure third party credibility. PHI products are not medical devices and no medical claims are made.

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