

## ACTIVEPURE® TECHNOLOGY

Safe, Effective, Proven, Certified

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ActivePure® is a patented exclusive environmental technology that can solve many everyday indoor air and surface contamination problems. ActivePure technology actively targets contaminants in the air and on surfaces, destroying them on contact. It does not require that the contaminant be sucked in and captured by a filter or be directly exposed to a UV light. It rapidly goes into all of the air in a given area to seek, attack, and quickly destroy contaminants. Importantly, it is safe to use in occupied rooms. It is the best technology available to mitigate airborne pathogens safely and quickly in an occupied space. Generally, it is relatively easy to retrofit ActivePure technology into existing HVAC systems.

Traditional passive technologies, such as HEPA or shielded UVC lights use filtration or other systems, which remove contaminants only if and when they travel through the purification unit. These traditional purification systems can help improve air quality to a degree, but they do not reduce surface contamination and do not adequately reduce many types of airborne contaminants. Other technologies such as Ozone or UVC light blasts only work in a limited radius and require direct exposure for a prescribed period of time. Additionally, many of these types of technologies are not safe to use in occupied spaces.

Often technologies either only “clean once, but only in unoccupied rooms” or “clean slowly and only partially in occupied rooms.” ActivePure “cleans continuously and quickly in occupied rooms.” It is the optimal choice to address rapid disinfection and decontamination of air in rooms occupied by people. Attached is a chart comparing other technologies with ActivePure (see Appendix A).

ActivePure technology is derived from NASA technology used on the International Space Station. It is the only Space Technology Hall of Fame and Certified Space Technology in the world in its class.

ActivePure technology utilizes a proprietary hydrophilic photo catalytic coating, consisting of non-nano titanium dioxide with a proprietary combination of additional transition elements to enhance efficiency. Activated by a specific wavelength of ultraviolet light, oxygen and humidity are extracted from the air to create a host of powerful oxidizers that target air and surface pathogens. These oxidizers are extremely effective at destroying viruses, bacteria, molds, volatile organic compounds (VOCs) and other environmental contaminants. ActivePure technology does not create harmful by-products or chemicals, but instead uses oxidizers found naturally occurring in the environment. These oxidizers actually reduce ozone and are not harmful to humans, pets or plants. They are completely safe for indoor use.

In 2020, the Aerus Medical Guardian™ received Class II Medical Device Clearance from the FDA, recognizing both the efficacy and safety of the ActivePure technology.

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7/13/2020

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## **Oxidizers**

The key oxidizers created by ActivePure technology are the following:

Hydrogen Peroxide ( $\text{H}_2\text{O}_2$ )

Hydroxyls ( $\text{OH}^-$ )

Hydroxyl Radicals ( $^{\circ}\text{OH}$ )

Super Oxides ( $\text{O}_2^-$ )

### **Hydrogen Peroxide ( $\text{H}_2\text{O}_2$ )**

A major oxidizer created by ActivePure technology is hydrogen peroxide ( $\text{H}_2\text{O}_2$ ), which has proven to be effective against indoor pathogens and contaminants on surfaces and in the air. ActivePure technology produces hydrogen peroxide molecules from the oxygen and humidity already present in the air. The hydrogen peroxide molecules are then carried throughout the indoor environment, neutralizing pathogens and contaminants in places that other technologies and filtration systems can't reach. Because hydrogen peroxide molecules have both positive and negative charges, they are drawn to pathogens and contaminants by the process of electrostatic attraction. Hydrogen peroxide is odorless, colorless and safe to use in occupied spaces. According to the Occupational Health and Safety Administration (OSHA), exposure to one part per million (1.0~ ppm) of hydrogen peroxide is considered safe throughout the day. ActivePure technology produces only 0.02 ~ 0.04 ppm, well below the OSHA limit.

### **Hydroxyls ( $\text{OH}^-$ )**

Another important oxidizer created by ActivePure technology are hydroxyl ions. Hydroxyls ( $\text{OH}^-$ ) are safe, naturally occurring, powerful oxidizers that quickly and safely neutralize many airborne and surface contaminants, viruses, odor-causing bacteria, and VOCs. As part of the ActivePure process, hydroxyls are formed when an ultraviolet light of specific wavelength is absorbed by the unit's proprietary coating. The coating strips the hydrogen (H) atoms from water molecules ( $\text{H}_2\text{O}$ ) in the ambient air, forming negative hydroxyls ( $\text{OH}^-$ ). These hydroxyls break down carbon and hydrogen-based organic contaminants and VOCs, converting them into harmless carbon dioxide ( $\text{CO}_2$ ) and water ( $\text{H}_2\text{O}$ ) vapor.

While extremely effective at destroying viruses, odors, bacteria, mold, VOCs and other contaminants, hydroxyls are also completely safe for human, animal and plant exposure indoors. The hydroxyls produced by ActivePure are the same as those produced naturally in the earth's atmosphere by the reaction of UV rays and water vapor, and function to safely and naturally "scrub" and decontaminate indoor environments.

### **Hydroxyl Radicals ( $^{\circ}\text{OH}$ )**

The hydroxyl radical,  $^{\circ}\text{OH}$ , is the neutral form of the hydroxyl ion ( $\text{OH}^-$ ). Hydroxyl radicals are diatomic molecules that are highly reactive, so reactive that they are instantly neutralized when they contact organic compounds such as viruses, fungi, bacteria, and many chemical VOC's by cracking the molecular bonds. Like the Hydroxyl ion, Hydroxyl radicals are formed by the

reaction of UV light disassembling water vapor ( $H_2O$ ) to get a hydrogen atom (H) and oxygen ( $O_2$ ) which are combined together to form the hydroxyl radical ( $^{\circ}OH$ ). Hydroxyl molecules are so quickly reactive that they are completely safe for human, animal and plant exposure indoors.

### **Super Oxides ( $O_2^-$ )**

Super oxides are oxygen molecules that arise when free hydrogen atoms (H) combine with naturally occurring ozone ( $O_3$ ) and are created in small amounts by nature in the air. When combined, they form the powerful oxidizers oxygen ( $O_2$ ) and hydroxyls ( $OH^-$ ). ActivePure technology utilizes a tuned UVC light source, naturally occurring ozone ( $O_3$ ), humidity and a photo catalyst to create powerful super oxides that eliminate viruses, bacteria, mold, and other contaminants. This technology is not only safe for human exposure but is significantly more effective at destroying contaminants than simple UV technology alone. In the process of creating super oxides, ActivePure actually reduces the amount of ozone ( $O_3$ ) that naturally exists in the air. Super oxides have been utilized for decades in food processing plants, hospitals, and dental and doctor's offices to control environmental contamination and disinfect safely without chemicals.

### **No Ozone**

Ozone ( $O_3$ ) is created naturally by nature and is present in our air. Ozone can also be created by man-made technologies. The EPA has determined that ozone at levels in excess of 0.07 ppm may be damaging to health. The State of California has implemented even tighter ozone levels at 0.05 ppm. ActivePure technology has been proven not to create ozone as it operates and can actually help lower naturally occurring ozone, as it creates safe super oxides ( $O_2^-$ ) which in turn eliminate harmful pathogens.

### **Product Efficacy and Testing**

ActivePure technology has consistently proven its ability to safely control and neutralize contaminants such as viruses, bacteria, mold, fungi and VOCs in numerous independent tests and studies, without harm to humans, animals and plant life. Extensive testing has shown ActivePure technology to be effective against RNA and DNA viruses including MS2, Phi-X147, H1N1, and H5N8, gram positive and gram negative bacteria including MRSA, Staph, Erwinia herbicola, Streptococcus, E-Coli, Listeria, C.Diff and Bacillus spp, and molds, including Aspergillus Niger, Bacillus globigii, Stachybotrys Chartarum and more. These studies have shown that ActivePure can reduce as much as 99.9999% of surface and airborne contaminants within the first 1-24 hours.

### **Aerus Medical Guardian Air Purification System (FDA Cleared)**

In 2020, the Aerus Medical Guardian received Class II Medical Device Clearance from the FDA after a multi-year vetting process. This flagship product with ActivePure technology is a free-standing, portable unit intended for use in professional healthcare environments, and is a 24/7

airborne contaminant reduction solution. The unit is the first of its kind, using ActivePure technology to continuously and actively purify the air.

The Aerus Medical Guardian is intended for medical purposes and is cleared for claims on the reduction of staphylococcus epidermidis and erwinia herbicola bacteria, MS2 and Phi-X174 viruses and aspergillus niger fungal spores and bacillus globigii bacterial spores from the air in a temperature-controlled professional healthcare environment of 70-71°F, 40-50% RH.

In order to receive Class II Medical Device Clearance, the FDA must be satisfied that the product lives up to its claims in two key areas: efficacy and safety. In the case of the Aerus Medical Guardian, efficacy is judged by the product's ability to deliver the contaminant reduction results for the six tested pathogens listed above. During testing done at an independent FDA-compliant laboratory, the Aerus Medical Guardian delivered 3–5 log reductions (99.9% – 99.999%) for all six contaminants within 30 minutes and 4–6 log reductions (99.99% – 99.9999%) within 60 minutes. ActivePure is the primary purification technology used in the Aerus Medical Guardian. The six graphs in Appendix B depict the powerful results of these tests.

When analyzing safety, the FDA requires the product be safely able to operate in a space occupied by people. Clearance by the FDA assures that ActivePure has been vetted fully for safety in occupied areas. With its origins in NASA's Space Program, ActivePure has been designed for safe use around people and animals since its inception. As Aerus has advanced the technology into its current more powerful version, that safety has remained the number one priority. The ability to disinfect a room safely and quickly while occupied by people is what makes ActivePure truly unique in the world of air purification technologies.

Upon receiving FDA Class II Medical Device Clearance, the Aerus Medical Guardian was given 501(k) Certificate Number K201220 (Appendix C).

### **Aerus Pure & Clean™**

ActivePure is also featured in many non-medical units sold by Aerus. This includes the Pure & Clean, Aerus' newly redesigned portable unit for residential and business use. The Pure & Clean is an evolution of the older FreshAir Everest product. During the update process, Aerus focused on a design that would allow for all 5 purification technologies present in the Medical Guardian unit to be functional in the Pure & Clean. While the ActivePure in this product would make this a powerful purifier without any other technologies, by supplementing it with HEPA, Positive and Negative Ionization, and Activated Carbon, the Pure & Clean provides outstanding performance in reducing airborne and surface contaminants.

## **Hydroxyl Blaster**

ActivePure alone is featured in Aerus' Hydroxyl Blaster, which operates with 4 ActivePure cells and a 300 CFM fan. This powerful unit is ideal for large crowded areas such as ballrooms and restaurants.

## **COVID-19**

Recently, Aerus tested ActivePure on COVID-19. We cannot speak to results as we are seeking FDA clearance to make claims, but we are confident that the results will be well received if and when cleared. In the meantime, we can make no express or implied claims that ActivePure is effective on COVID-19.

## **Summary of Passive Air Purification Technologies on the Market**

One of the main advantages of ActivePure technology is that it **actively** sends oxidizers into the room, filling the air with molecules that attack and reduce contamination both in the air and on surfaces. It works safely, powerfully, quickly and invisibly in rooms occupied by people where the need for immediate remediation is essential if infected people enter or occupy the space. ActivePure in effect goes out into people-filled rooms and chases down pathogens to kill them.

This is unique because most of the common air purification technologies on the market are **passive**, meaning they require the contaminant to travel to the product before the reduction can take place. This requirement limits the effectiveness of these products because they only work on airborne contaminants, not surfaces, and are highly dependent upon air changes per hour (airflow created by the product's fan).

For consumers concerned with real-time reduction of contaminants as they are reintroduced by people entering and exiting the space, an active solution like ActivePure is the only way to attack those pathogens around the room without waiting for the product to circulate the air. Even for the high-end products with a strong fan providing powerful airflow, there will still only be a few air changes per hour, meaning that any new contaminants introduced into the room will linger for an uncomfortable amount of time.

## **Ultraviolet-C (UVC) Light**

Ultraviolet-C light is a sterilizing spectrum of light that can be effective in reducing pathogens. However, the UVC light is dangerous if viewed by the naked eye. As a result, it is always hidden, or is only used in unoccupied spaces. A UVC air purifier may work by simply being placed behind a shield, where it waits for pathogens to pass by. Or it may operate by using a fan to create airflow in the room that draws the pathogens into the product where it passes through a field of UVC light. Major limitations of the efficacy of UVC products include: the passive (capture) nature of the purification process, the high exposure times needed for UVC to kill microbes

thereby limiting effectiveness for high capacity needs, the efficacy is reduced as the bulb surface gets dirty over time, and it does not reduce VOC's, odors, or particulates.

### **Photocatalytic Oxidation (PCO)**

Photocatalytic Oxidation is another slow-working, passive, but mildly effective technology that works by irradiating a titanium dioxide (TiO<sub>2</sub>) coating with UVC light to create an ionized sterilization field around the TiO<sub>2</sub> coating. A fan inside the product draws airborne contaminants into the ionized field where they are reduced before the cleaner air is pushed back into the room. While the PCO field can be one of the more effective sterilization technologies, it is still limited by being a passive technology that requires the airborne pathogen to be carried into the product where it needs adequate exposure time and can create harmful byproducts if incomplete oxidation occurs.

### **Electrostatic Precipitation (ESP)**

An electrostatic precipitator uses electrostatic force to grab and hold dust and other particles. It consists primarily of wires and collection plates, with a high voltage applied from an electrostatic field between the wires and the collecting plate, charging the air electrically. Airborne particles are gathered on the collection plates, removing them from the air. ESP products require frequent cleaning to remove the collected particles, and this can cause human exposure to concentrated contaminants if not done carefully. With less frequent cleaning, the efficacy of ESP can drop by as much as 20% after just a few days of use. Some ESP units have also been found to create Ozone as a byproduct, which can cause health issues for some people after prolonged exposure.

### **High Efficiency Particulate Air (HEPA)**

HEPA filters, a technology dating to the 1950s, are one of the most commonly used air filtration products. Like other passive technologies, a fan is used to draw airborne contaminants into the product, where they pass through a HEPA filter and are captured in the fibers, removing them from the air. True HEPA can be effective at particulate removal but does have limitations. These include inefficiency in removing particles smaller than 0.3 microns (including some viruses) as well as an inability to remove VOC's, smoke, or other gases. Also, it is usually problematic to retrofit HEPA filters into most commercial HVAC systems due to back pressure issues.

### **Activated Carbon**

A carbon or charcoal filter is a bed of activated carbon, typically in granular or powdered block form, and consists of millions of tiny absorbent pores that react chemically to the pollutants, removing them from the air. Activated carbon can work well on odors, VOC's, smoke, and chemicals, but due to the large pore size in the carbon bed it does not perform well in removing

viruses, bacteria, and other small particles. A fan is necessary to achieve reasonable results from this passive technology.

### **Summary of Other Active Air Purification Technologies on the Market**

Although most air purification products on the market are passive, there are a few other active purification technologies available to consumers. However, when compared to ActivePure, they all fall short in either efficacy or because of safety restrictions around their use in occupied spaces.

#### **Ozone (O<sub>3</sub>)**

Ozone is one of the more powerful air purification technologies on the market. Most ozone generating products create ozone using corona discharge or UV radiation. While ozone is one of the most powerful oxidizing agents available, there are many studies that indicate prolonged exposure can cause damage to lung tissue. For this reason, ozone products cannot be sold into California in the US, and Canada. Several other countries have also banned ozone products for safety reasons. These health risks typically limit ozone's use to unoccupied spaces. It is generally not a preferred choice for those concerned with real-time reduction of airborne and surface pathogens in occupied spaces.

#### **Ionization**

Ionization is a somewhat active air purification technology that creates negatively charged ions that can spread throughout some or all of the air in a given space. Most airborne particles are positively charged and when the negative ion and positive particles meet, they bond together, creating a heavier particle that may no longer stay airborne. The biggest weakness of ionizers is that they have not been proven to actually remove or destroy any of the particles. Instead, those particles fall to the floor, tabletops, or other surfaces, where they must be removed by a vacuum or other cleaning product. In the time between those two steps, the surfaces are contaminated and can be kicked back up into the air by people walking in the space. For a customer looking to quickly reduce or destroy contaminants in a space, an ionizer is not an efficacious choice, although pathogens pulled into the immediate electrical generator of the ions can be neutralized. Per ASHRAE, "convincing scientifically rigorous, peer-reviewed studies do not exist on this technology; manufacturer data should be carefully considered." Ionizers also do not reduce surface contamination and as noted can increase it.

#### **Dry Hydrogen Peroxide (H<sub>2</sub>O<sub>2</sub>)**

Dry Hydrogen Peroxide is essentially H<sub>2</sub>O<sub>2</sub> gas. This is the same gas created by ActivePure. Dry Hydrogen Peroxide generators do not create the beneficially other hydroxyls and oxidizers created by ActivePure. As a result, they generally are inferior in tested performance results to ActivePure. Some also generate H<sub>2</sub>O<sub>2</sub> in concentrations exceeding OSHA safety guidelines. In

looking at this type of technology, one should carefully review safety issues and the validity and integrity of the manufacturer's test data.

### **About Aerus**

Aerus LLC was founded in 1924 as Electrolux USA. The Dallas, TX based firm specializes in cleaning, sanitizing and disinfecting air, surfaces and water in occupied spaces. Most products employ its patented ActivePure technology. ActivePure product offerings include small personal units, portable room size units, whole house residential units and large space commercial units. Its customers include governments, professional sports teams, commercial firms, medical facilities, HVAC companies, and individual consumers. Other products include water purification systems and cleaning appliances. Additional information can be found at [www.activepure.com](http://www.activepure.com) and [www.aerusmedical.com](http://www.aerusmedical.com).

## Appendix A

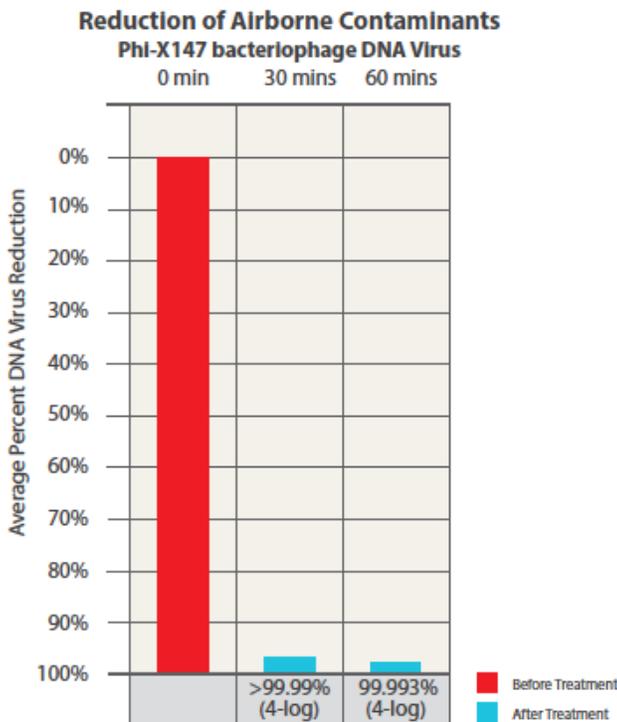
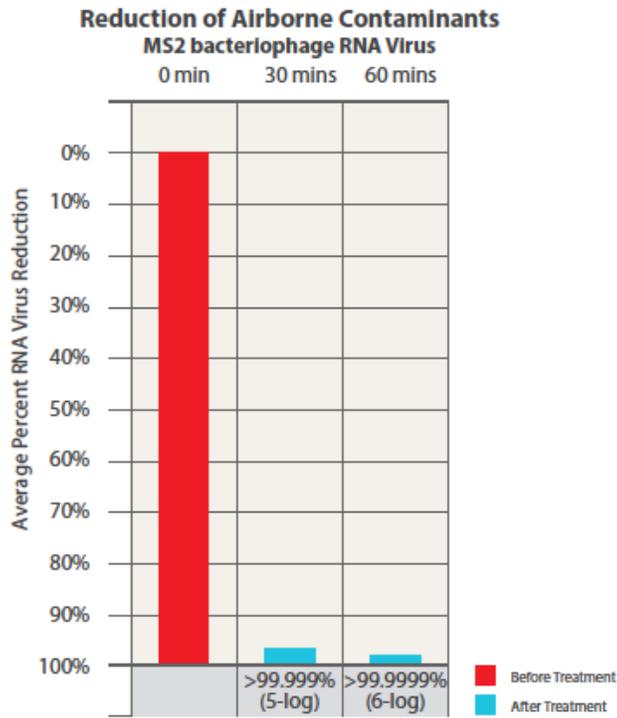
### Comparative Chart - ActivePure® vs. Others

	ActivePure®	Shielded UVC	Unshielded UVC	Ionization	PCO	ESP	HEPA	Activated Carbon	Ozone
Works Safely in Occupied Rooms	YES	YES	NO	SOME	YES	SOME	YES	YES	NO
Quickly Destroys Airborne Viruses, Bacteria, Molds (Active Technology) Does not require Capture or Exposure Time	YES	NO	YES	NO	NO	NO	NO	NO	YES
Slowly Destroys Airborne Viruses, Bacteria, Molds Requires Capture or Exposure Time and Pathogen	NO	YES	NO	not clear (ASHRAE)	YES	NO	SOME	NO	NO
Destroys Surface Viruses, Bacteria, Molds (Active Technology)	YES	NO	YES	NO	NO	NO	NO	NO	YES
Dangerous, Legally Restricted, or can cause Collateral Damage	NO	YES	YES	YES	NO	YES	NO	NO	YES
Quickly Reduces Re-contamination	YES	NO	NO	NO	NO	NO	NO	NO	YES
Removes VOCs	YES	NO	NO	NO	SOME	NO	NO	YES	YES
Reduces PM 2.5 Particles or Smaller	NO	NO	NO	SOME	NO	YES	YES	NO	NO
Can Impede a HVAC System	NO	NO	NO	YES	NO	NO	YES	YES	YES
Requires Frequent Cleaning or Replacement	NO	YES	YES	NO	NO	YES	YES	YES	NO
Can Only be Used Safely in Unoccupied Areas or is Unsafe to Clean	NO	NO	YES	SOME	NO	SOME	YES	NO	YES
Cleared by FDA as a Class II Medical Device	YES	YES	YES	SOME	YES	NO	YES	NO	NO
CARB Certified	YES	YES	NO	NO	YES	SOME	YES	YES	NO
NASA Space Foundation Hall of Fame	YES	NO	NO	NO	NO	NO	NO	NO	NO

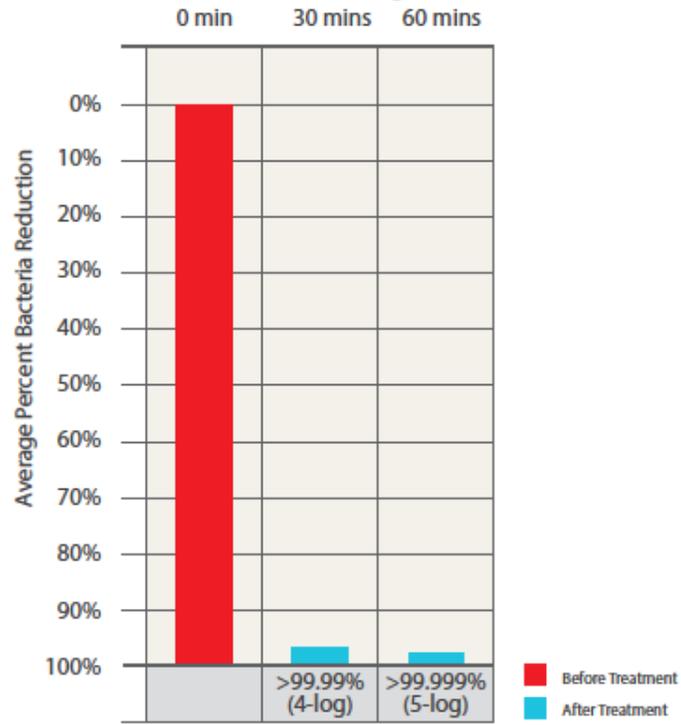
The above is compiled based on data available to us.

Rev. 06.30.20

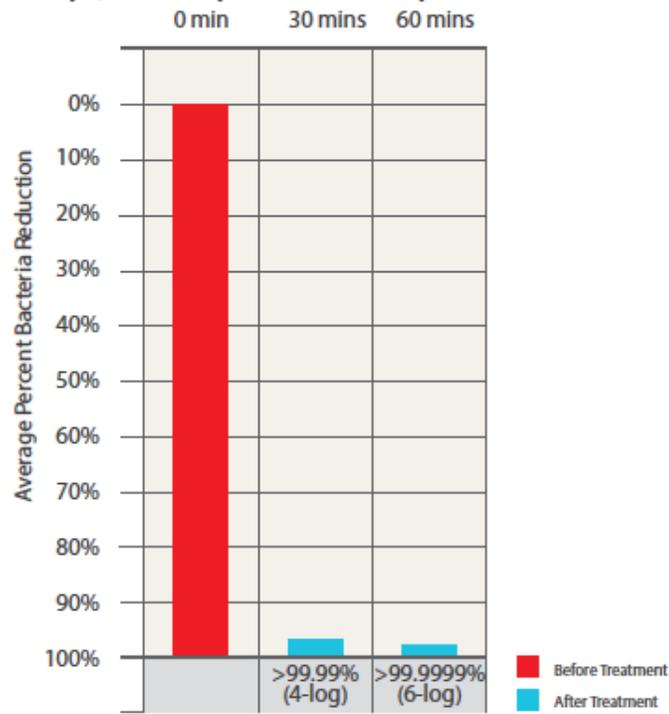
**Appendix B**

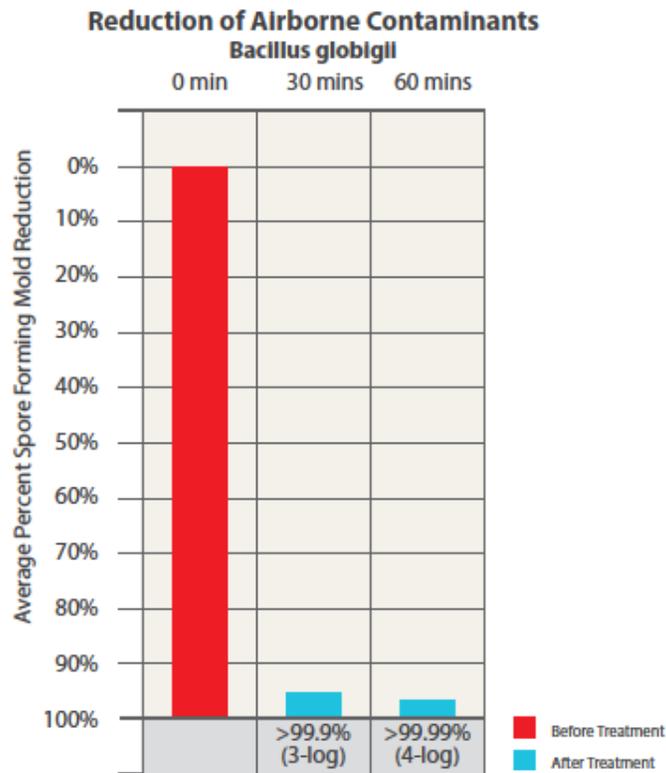
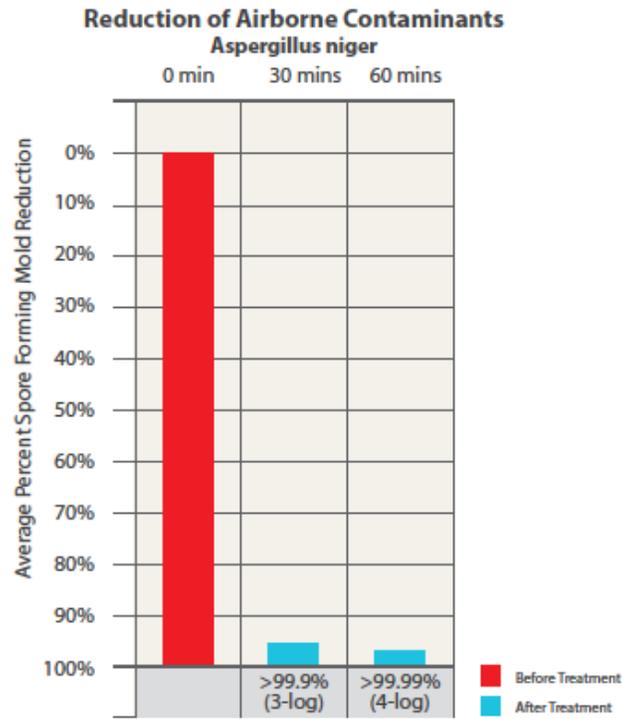


**Reduction of Airborne Contaminants**  
***Erwinia herbicola* – Gram-negative Bacteria**



**Reduction of Airborne Contaminants**  
***Staphylococcus epidermidis* – Gram-positive Bacteria**





### Appendix C

DEPARTMENT OF HEALTH AND HUMAN SERVICES Food and Drug Administration	Form Approved: OMB No. 2970-0120 Expiration Date: 06/30/2020 See PRA Statement Below			
<b>Indications for Use</b>				
510(k) Number (If known)				
K201229				
Device Name				
Acrus Medical Guardian, model F170A				
Indications for Use (Description)				
<p>The Acrus Medical Guardian, model F170A is a device intended for medical purposes that is used for the reduction of staphylococcus epidermidis and erwinia herbicola bacteria, MS2 and Phi-X174 viruses and aspergillus niger fungal spores and bacillus globigii bacterial spores from the air in a temperature-controlled professional healthcare environment of 70-71°F, 40-45% RH.</p> <p>The Acrus Medical Guardian, model F170A demonstrated the reduction of staphylococcus epidermidis and erwinia herbicola bacteria, MS2 and Phi-X174 viruses and aspergillus niger fungal spores and bacillus globigii bacterial spores under the following conditions.</p>				
Organism Type	Organism Name	Test Temp/RH	Exposure Time (min)	Avg Log-Reduction
Bacteria	Staphylococcus epidermidis	72°F / 50%	60	5.95
Bacteria	Erwinia herbicola	72°F / 50%	60	5.12
Virus	MS2	72°F / 50%	60	5.58
Virus	Phi-X174	72°F / 50%	60	4.19
Fungal Spore	Aspergillus niger	72°F / 50%	60	4.12
Bacterial Spore	Bacillus globigii	72°F / 50%	60	4.22
Type of Use (Select one or both, as applicable)				
<input type="checkbox"/> Prescription Use (Part 21 CFR 801 Suspect E) <span style="margin-left: 100px;"><input checked="" type="checkbox"/> Over-The-Counter Use (21 CFR 801 Suspect C)</span>				
<b>CONTINUE ON A SEPARATE PAGE IF NEEDED.</b>				

**Appendix D**

**Reduction of Surface Contaminants**

ActivePure® Technology tested with earlier generation of the cell

