



BioProtector Air Sterilization System



BioProtector™

- BioProtector is a standalone device that is inserted in-line with the air duct of the HVAC system. Air flows into BioProtector, which uses high intensity, Advanced Ultraviolet (UV) System (AUVS) technology to rapidly and effectively destroy any biological organisms that may be present and then continues in the air as it flows through the air duct.
- BioProtector achieves such high intensity UV by directing the air stream through a reflective cavity. In an approach analogous to that of a microwave cavity, the reflective cavity allows the UV photons to make many transits and the UV intensity is significantly increased.
- Though other UV-based air-cleaning systems utilize reflectors, BioProtector distinguishes itself by the use of a unique cavity technology that produces higher reflectivity in the ultraviolet range. As a result, the UV within the reflective cavity is very intense and uniform. This innovation enables greater neutralization of airborne biological contaminants without increasing the power, size and cost of the system.
- BioProtector provides comprehensive UV-based protection for rooms, buildings, hospitals, and shelters. Because of its moderate power consumption, pressure drop, and size, it is an especially good option for those who are considering retrofits to protect high-threat buildings.



Intense UV Technology Development

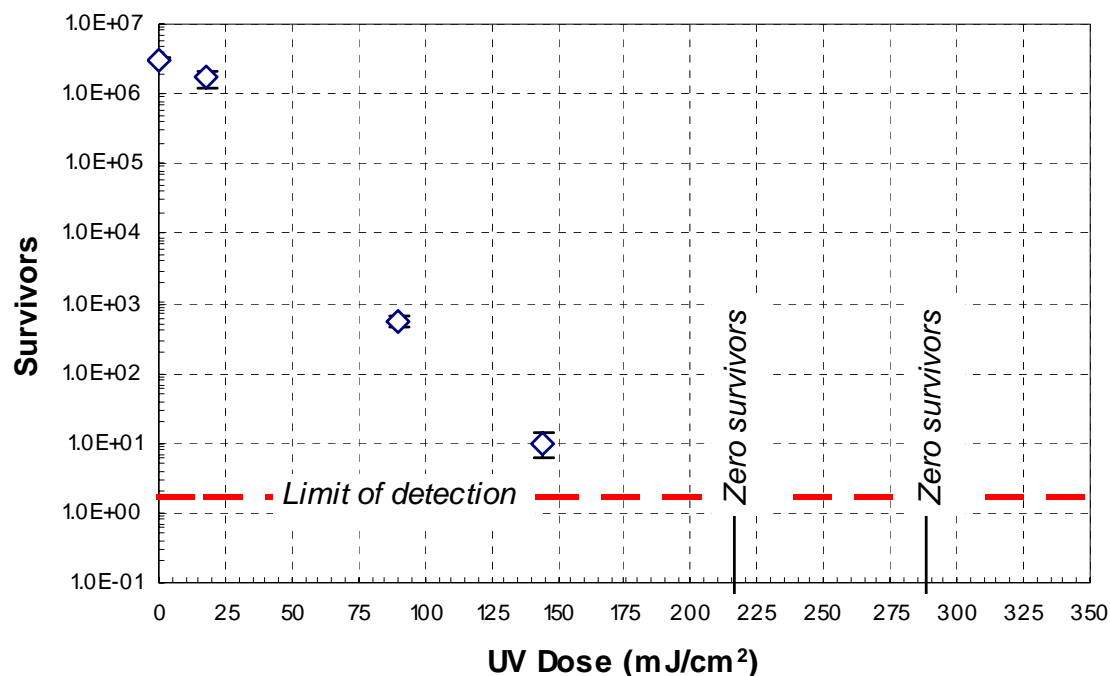
- Developed Advanced UV System (AUVS) technology
- Demonstrated > 6 logs kill of resistant endospores
 - Very high dose / flux density required
- Developed flux multiplication technology
 - Increases flux density without increase in power
- Performed lab, field and third party validation tests
- Developed and validated engineering model
 - Predicts performance, power requirements, defines design parameters



Laboratory Kill Measurements

- Measured kill of *B. subtilis* in water suspensions
- Up to ~7 logs kill

Dose response ~ 25mJ/cm²/log





UV Kill of Microorganisms

Organism	Type	Reference	Test Medium	D Value (90% Kill) (micro Joules/cm ²)
<i>Bacillus subtilis</i>	Endospore	Novatron, 2003	Plates, Air	25,000
<i>Bacillus anthracis</i>	Endospore	Sharp, 1939	Plates	4,520
Influenza A	Virus	Jensen, 1964	Air	1,940
Vaccinia	Virus	Jensen, 1964	Air	2,080
<i>Mycobacterium tuberculosis</i>	Mycobacteria	David, 1973	Air	2,330
Legionella pneumophila	G- Bacteria	Gilpin, 1984	Water	1,120
Staphylococcus aureus	G+ Bacteria	Sharp, 1940	Air	660

- *B. Subtilis* endospores are highly resistant (D=25,000 $\mu\text{J}/\text{cm}^2$)
- Much higher kill for other organisms such as Anthrax



Photon Trap Concept

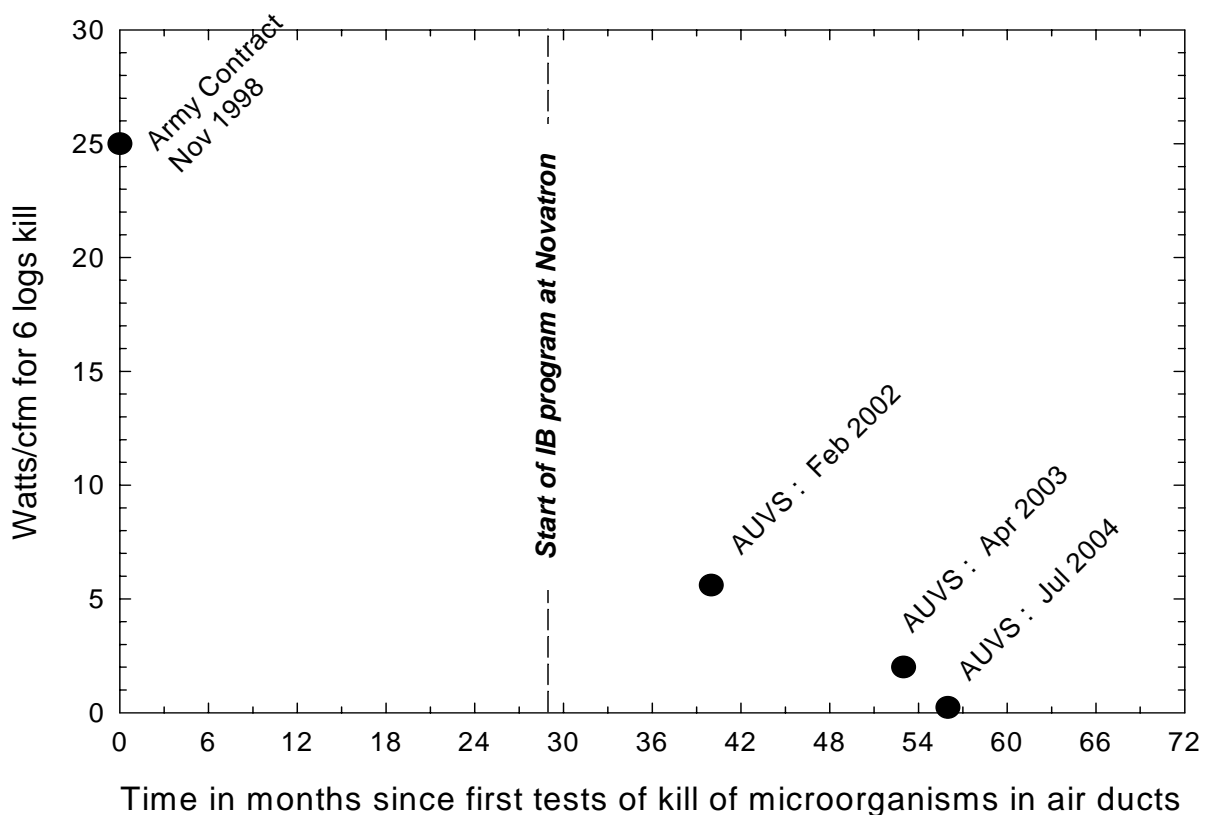
- UV absorption lengths are long in air
- Important to deposit UV energy in organisms rather than lose energy to walls and end losses
- Highly reflective surfaces and design to trap photons
 - Multiply fluence by 30 to 50X
 - Uniform fluence from all directions

Increases efficiency, reduces size, cost and power by large factors

(10 to 50X)



Power Consumption Improvements



Allows appliance-like power levels (~1.5 kW for 2000 cfm)



BioProtector™ BP114i





BP 246i BioProtector™

The ultimate in biological protection for buildings, rooms, hospitals, shelters, etc.





BP7912A 60,000 CFM BioProtector








Pentagon Installation





BioProtector™ Specifications

Product / Model Number	 BP114	 BP246	 BP 7912A
Nominal Flow (cfm)	500	3,500	60,000
Typical Flow Range (cfm)	250 – 1,000	2,000 – 7,000	40,000 - 120,000
Dimensions W x H x L (ft)	1 x 1 x 4	2 x 4 x 6	7x 9 x 12
Number of Lamps*	6	8	68
Electrical Power (Watts)*	1200	3200	28,000
Lamp Life (Hours)	16,000	16,000	16,000
Pressure Drop (iwg)*	< 0.3	< 0.3	< 0.3

* Nominal flow rate