SANUVOX

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TECHNOLOGIES

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Who is Sanuvox

- Canadian company founded in 1995
- Develops & Markets proprietary Ultraviolet Air & Object Purification Systems
- Manufactures complete line of UV systems for:
  - Residential
  - Commercial
  - Institutional
  - Medical
  - Military Applications
- Global leader in Ultraviolet Air & Object Purification

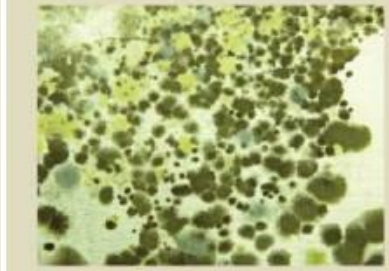
SAN·UV·OX

SANitary
Ultra**V**iolet
OXidation

Are you familiar with “UV Lights”

SANUVOX

The “IAQ” ISSUES


mold


viruses


bacteria


dust mite fecal matter


smog


cooking odors


cigarette smoke & odors


lingering odors


pet odors & dander


VOCs & chemicals


allergy & asthma triggers


sick building syndrome

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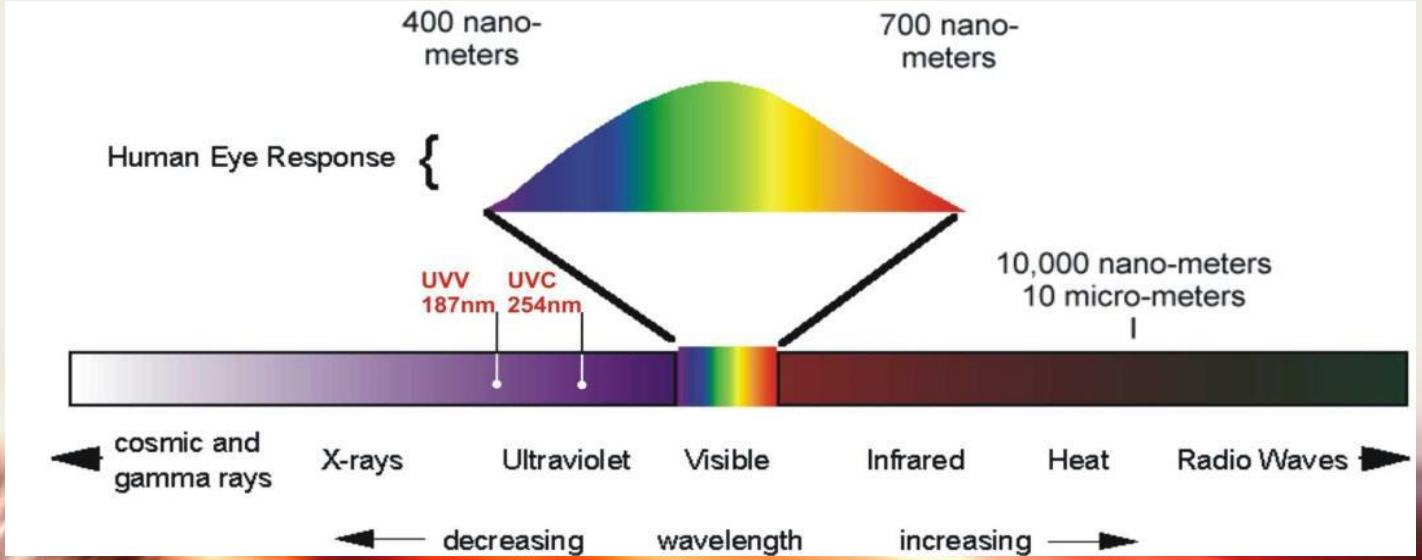
Ultraviolet Light

The Sun purifies the Earth's atmosphere by bombarding it with Ultraviolet Light.

Ultraviolet-C (254 nanometers) & Ultraviolet-V (187 nanometers) light destroys the biological & chemical contaminants within our atmosphere.

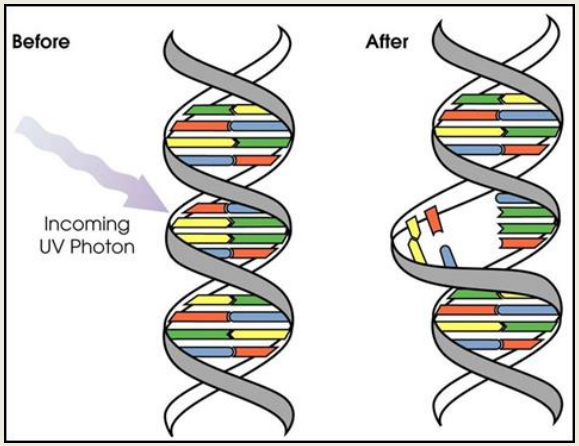
Sanuvox High-Intensity UV Lamps produce the same UV-C & UV-V Light the Sun produces bringing the same purification process into the building.

Ultraviolet	Wavelength
UV – A	315 to 400 nm
UV – B	280 to 315 nm
UV – C	200 to 280 nm
UV – V	100 to 200 nm



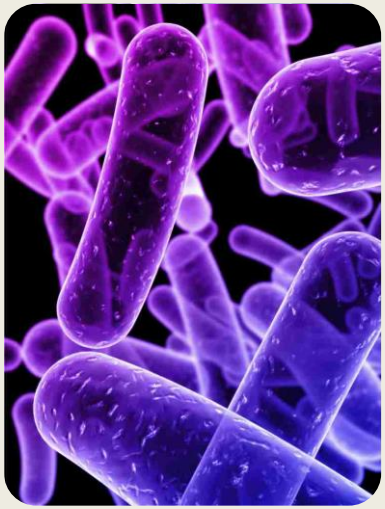
Ultraviolet UVC Germicidal Light

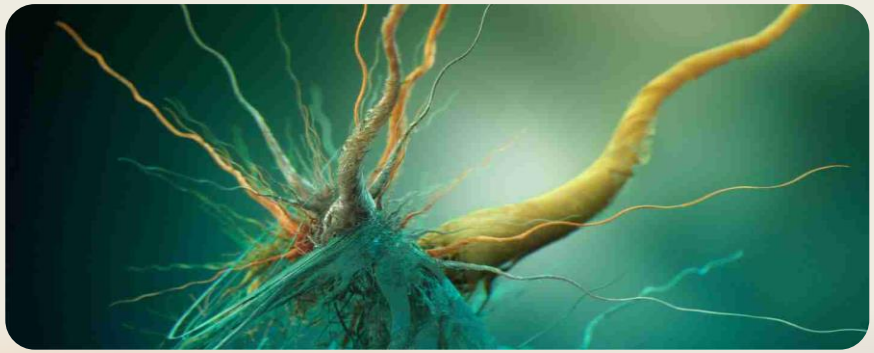
UVC Germicidal Ultraviolet wavelength (254nm) is effective in penetrating the cell membrane breaking the DNA structure of a micro-organism. DNA sterilization inhibits reproduction.



Ultraviolet radiation can damage DNA by distorting its structure. Credit: NASA's Earth Observatory/David Herring. Image courtesy of www.nasa.gov

Micro-organisms such as mold, bacteria & viruses will be destroyed with the **required concentrations of germicidal energy.**





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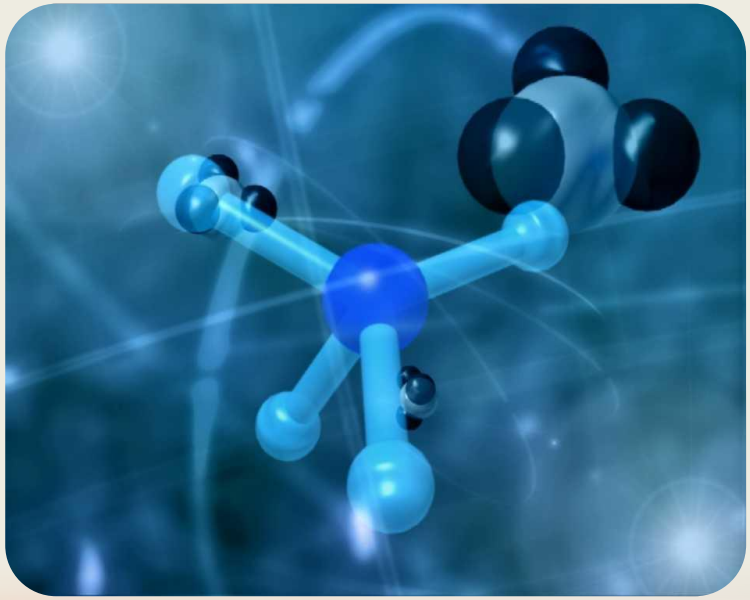
Ultraviolet UVV Oxidizing Light

UVV Oxidizing Ultraviolet Wavelength (187nm) is effective as an oxidizing reactor.

UVV produces activated oxygen atoms that react to chemicals, odors and VOCs degrading them by successive oxidation into odorless & inoffensive byproducts.

Effective at destroying chemical contaminants such as cigarette smoke, formaldehyde, solvents, diesel fumes, odors & VOCs



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ASHRAE & UV: Past, Present & Future

<2005 IUVA (International Ultraviolet Association) was the predecessor to ASHRAE

2005 - ASHRAE SPC 185 formed

2005 ASHRAE Technical Group (TG)2.UVAS

This resulted in the first Handbook chapter regarding UV in 2008, titled:
UV Lamp Systems

Since 2008, there have been Two additional chapters in ASHRAE Handbooks:

2011 Handbook: HVAC Applications : Chapter 60: Ultraviolet Air and Surface Treatment Applications

2012 Handbook: "HVAC Systems and Equipment: Chapter 17: Ultraviolet Lamp Systems which includes information from Research Project 1509-RP on the degradation of Typical HVAC Materials, Filters and Components Irradiated by UVC Energy.

Moving Forward:
More Research Projects and RTARS.
Expanding the knowledge base of UVC

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Using UV Effectively

TIME: The greater the exposure time (contact time between the contaminant and the UV source) the more UV energy can be delivered to the contaminant resulting in a greater Kill Rate.

INTENSITY: The greater the intensity (strength of the UV source) the more UV energy can be delivered to the contaminant resulting in a greater Kill Rate

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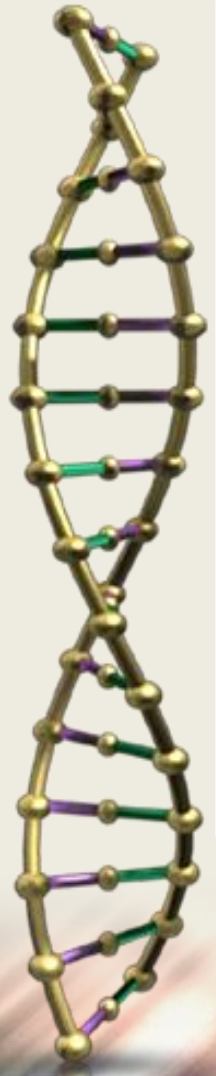
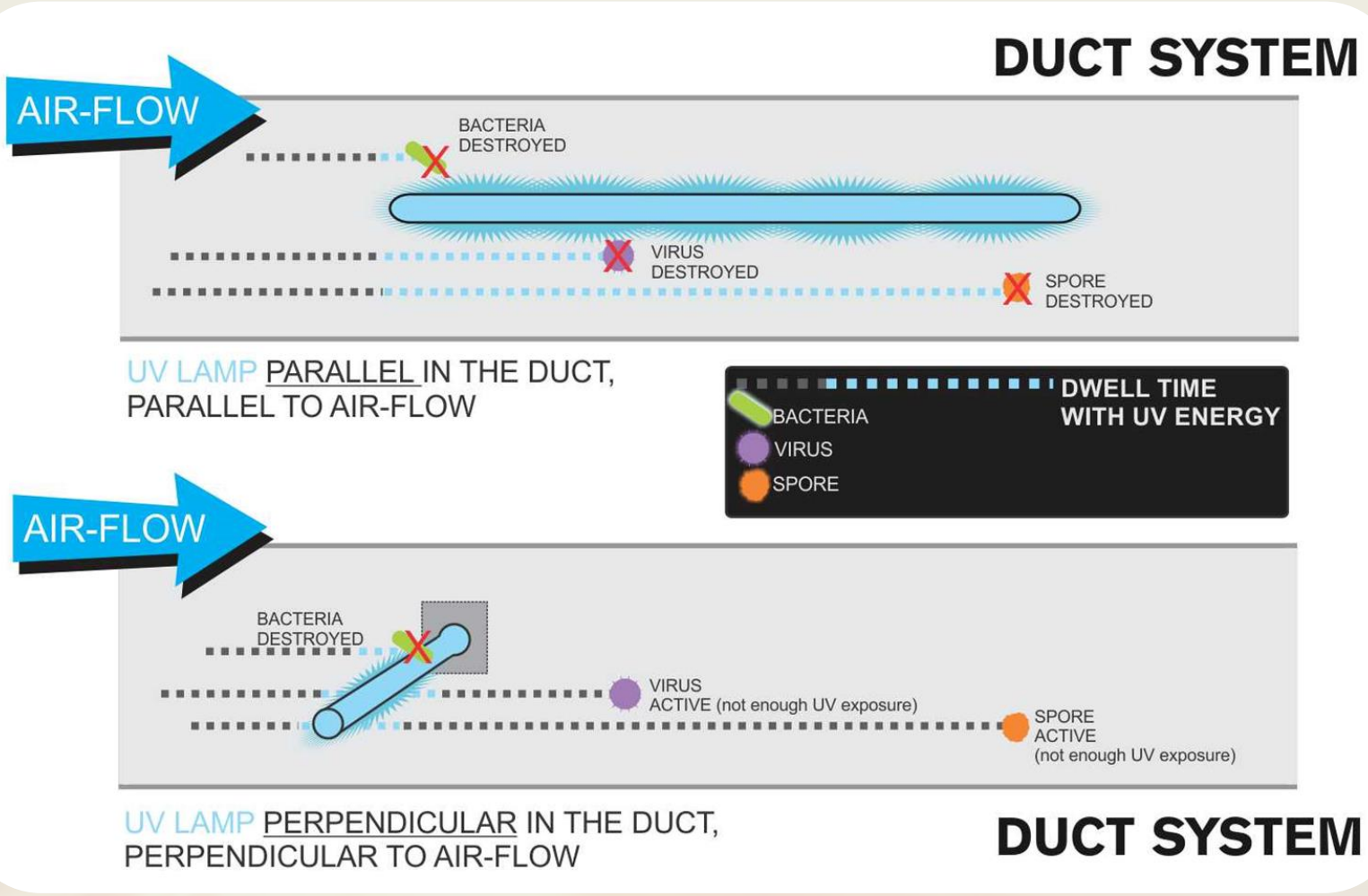
Dwell Time: Parallel





Reflection

- Direct virtually 100% of the Lamp's UV energy where needed most

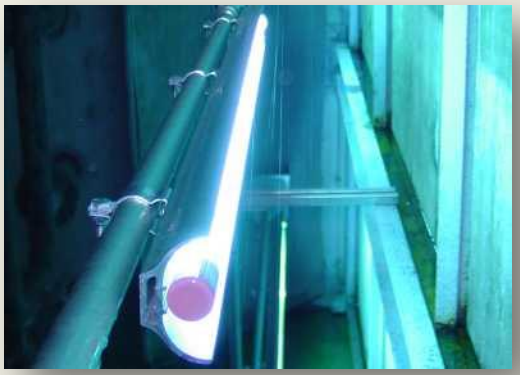
- Protects the UV Lamp from air buffeting (air striking the UV Lamp) which results in better efficiency

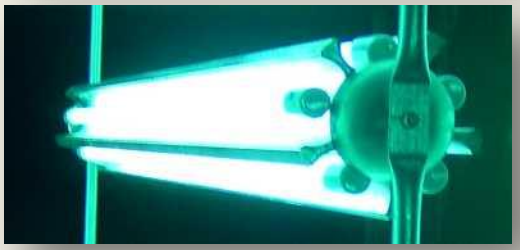
- Dramatically increases Lamp life

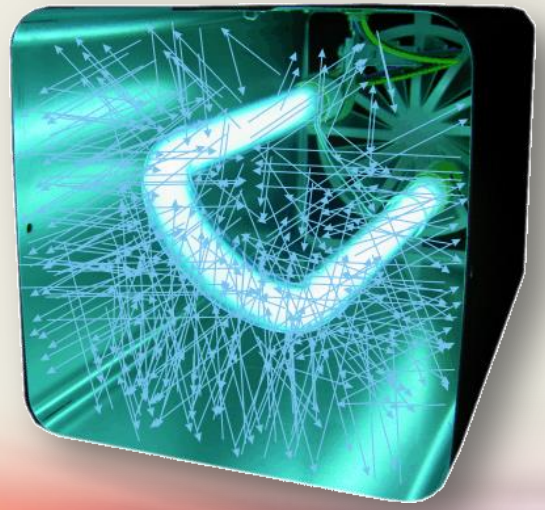
- Allows the Lamp to be self-cleaning by directing UV back on itself burning off the bio-aerosols that adhere to the Lamp surface

- Protects plastics and rubber from dangerous UV exposure

- Supports Lamps that may be as long as 60" protecting them from breakage







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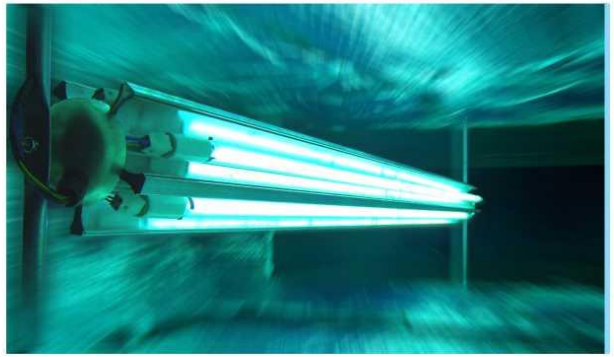
The Question: Air or Coil?

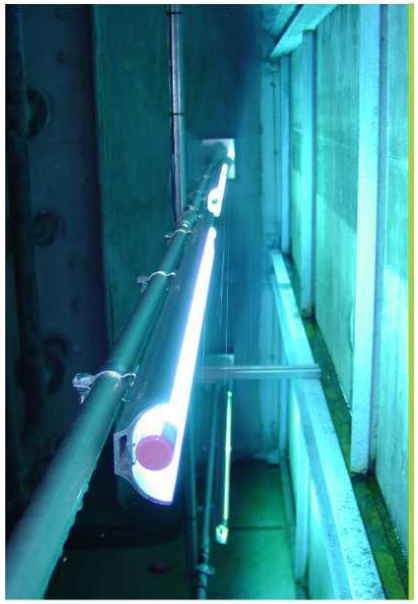
AiR



Destroy bio-chemical contaminants
circulating through the facility

AiR: SHORT EXPOSURE TiME

COiL



Destroy mold & other microbial
growth on the coil & surrounding areas.
Improve energy efficiency by maintaining a clean coil

COiL: LONG EXPOSURE TiME

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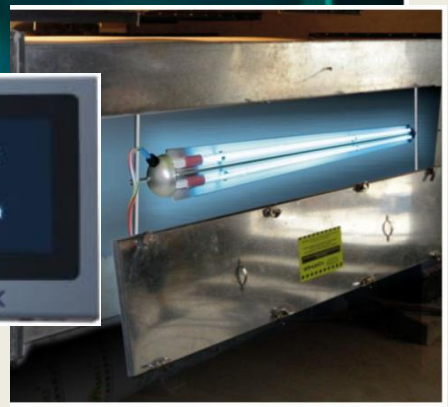
Commercial In-Duct Air Treatment



UV Bio-Wall Max
- Available in sizes up to 60” in length
- For large systems
- Optional remote Touchscreen monitor

UV Bio-Wall QUATTRO
- Treat 100% of the air on one pass

The UV Bio-Wall was EPA & Homeland Security (NHSRC) tested against Biological Warfare against (BWAs).

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Commercial In-Duct Air Treatment

UV Bio-Wall Max

- Dramatically improves Indoor Air Quality
- Continuously treats the entire duct
- Destroys up to 99.9999% of bio-chemical contaminants
- Available in 24”, 30”,40”, 50” and 60”
- 5 High-Intensity Pure Fused 19mm. Quartz UVC Lamps
- Anodized Aluminum Parabolic Reflectors maximizes UV energy
- Digital Timer. LED & Audible Alarm on Control Panel
- Available with Dry Contacts
- 2 year Lamp warranty; 15 year Ballast Warranty
- CSA C/US Certified and CE Approved
- New Optional Remote BioMax Smart Touchscreen Monitor

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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UV Bio-Wall Sizing

To size the UV Bio-Wall, we simply need to know the:

Duct Size

CFM or FPM

With that, we can provide free-of-charge the “Real-Time” Kill-Rates per pass.

SANUVOX TECHNOLOGIES BIOWALL SIZING

NOTE: RESULTS ARE AS AT LAMP CHANGEOUT TIME (17,000 OPERATING HOURS)

INACTIVATION

8 Pass Inactivation Rates

Calculated UVC dose

minimum	15.084 J/m2
average	27.288 J/m2
maximum	244.702 J/m2

TARGET

influenza A virus — Required for Inactivation

Number of Passes	1	2	3
Minimum %	83.31%	97.21%	99.54%
Average %	96.08%	99.85%	99.99%
Average LOG	1	2	4

tuberculosis — Required for Inactivation

Number of Passes	1	2	3
Min %	95.99%	99.84%	99.99%
Average %	99.70%	100.00%	100.00%
Average LOG	2	5	7

smallpox — Required for Inactivation

Number of Passes	1	2	3
Min %	90.02%	99.00%	99.90%
Average %	98.45%	99.98%	100.00%
Average LOG	1	3	5

parvovirus — Required for Inactivation

Number of Passes	1	2	3
Min %	62.94%	86.26%	94.91%
Average %	83.40%	97.24%	99.54%
Average LOG	0	1	2

Note: A 4 Log inactivation equals 99.99%. An inactivation that is greater than
For example an Average Inactivation Rate of 99.9992% would be shown as 1

SANUVOX TECHNOLOGIES BIOWALL SIZING PROGRAM

NOTE: RESULTS ARE AS AT LAMP CHANGEOUT TIME (17,000 OPERATING HOURS)

SINGLE PASS* Inactivation (Sterilization)

Basic Engineering Data

BIOWALL Model and number of units	Bio 60	1 Unit(s)
Selected BIOWALL unit length		60 in
Duct width		96.00 in
Duct height		72.00 in
Airflow		30000 CFM
Air velocity in the free duct		625.00 ft/min
Air velocity at BioWall section		626.44 ft/min
Pressure drop at Biowall installation point		0.0003 in H2O
Total power consumption		736 W
Air temperature increase due to BioWall system		0.04 °C
AVG APPLIED Germicidal UV dose to the air stream		2729 µJ/cm2

SINGLE PASS* INACTIVATION (STERILIZATION) RATES

	Minimum	Average	LOG
influenza A virus	83.31%	96.08%	1
tuberculosis	95.99%	99.70%	2
smallpox	90.02%	98.45%	1
parvovirus	62.94%	83.40%	0

A 4 Log inactivation equals 99.99%. An inactivation rate that is greater than 99.99% is shown as 100% with the corresponding Average Log Reduction. For example an Average Inactivation Rate of 99.9992% would be shown as 100% and the Average Log reduction would be 5.

*Single Pass Inactivation means that the air is exhausted after it is treated and is not recirculated

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UV Bio-Wall Sizing

SANUVOX TECHNOLOGIES BIOWALL SIZING PROGRAM

NOTE:RESU

RECIRCULATION* Inactivation (Ste

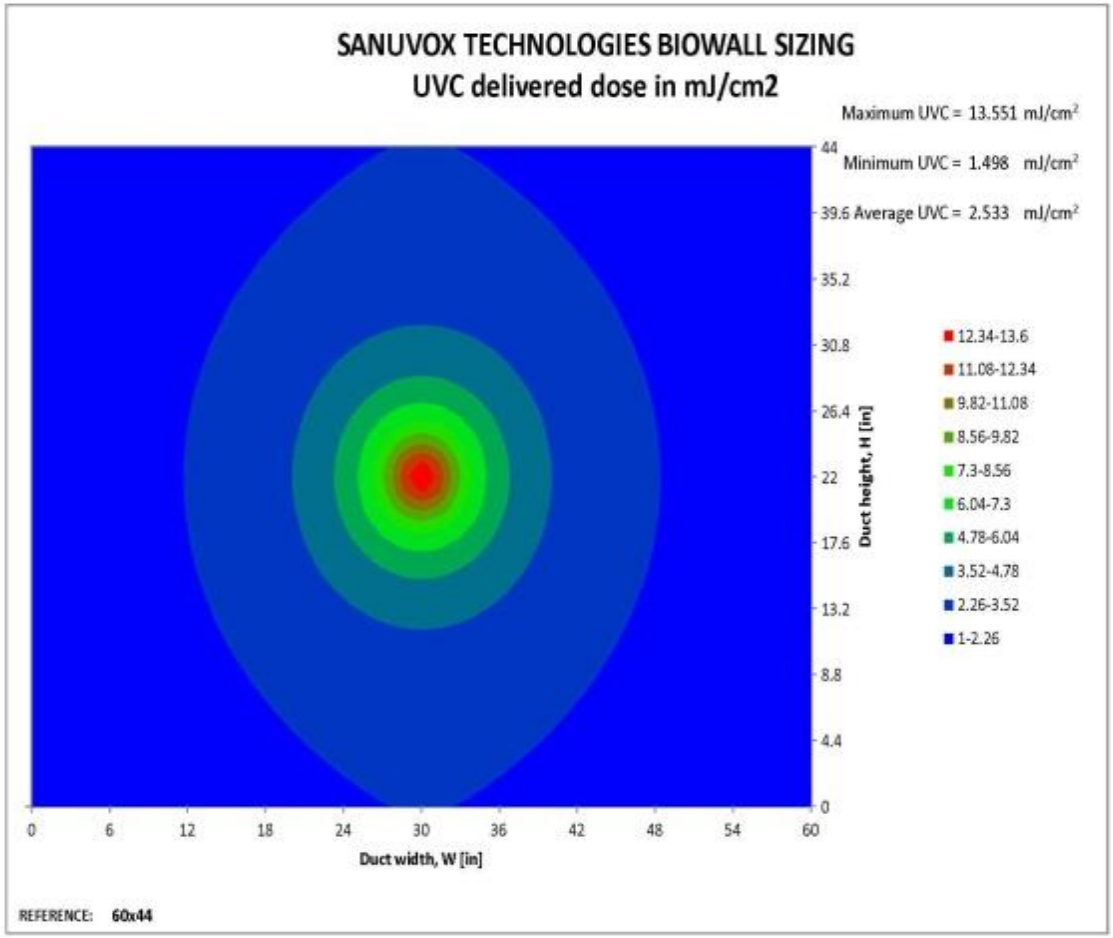
Basic Engineering Data

BIOWALL Model and number of u	
Selected BIOWALL unit length	1 Unit(s)
Duct width	18 in
Duct height	28.00 in
Airflow	14.00 in
Air velocity in the free duct	2700.00 CFM
Air velocity at BioWall section	991.84 ft/min
Pressure drop at Biowall installati	1033.78 ft/min
Total power consumption	0.0159 in H2O
Air temperature increase due to B	145 W
AVG APPLIED Germicidal UV dose	0.09 °C
	1288 µJ/cm2

RECIRCULAT

	Minimu
influenza A virus	99.90
tuberculosis	100.00
smallpox	99.99
parvovirus	97.88

A 4 Log inactivation equals 99.99%. An inac
Average Log Reduction. For example an Av
reduction would be 5.



SANUVOX TECHNOLOGIES BIOWALL SIZING PROGRAM

000 OPERATING HOURS)

DSU-B1

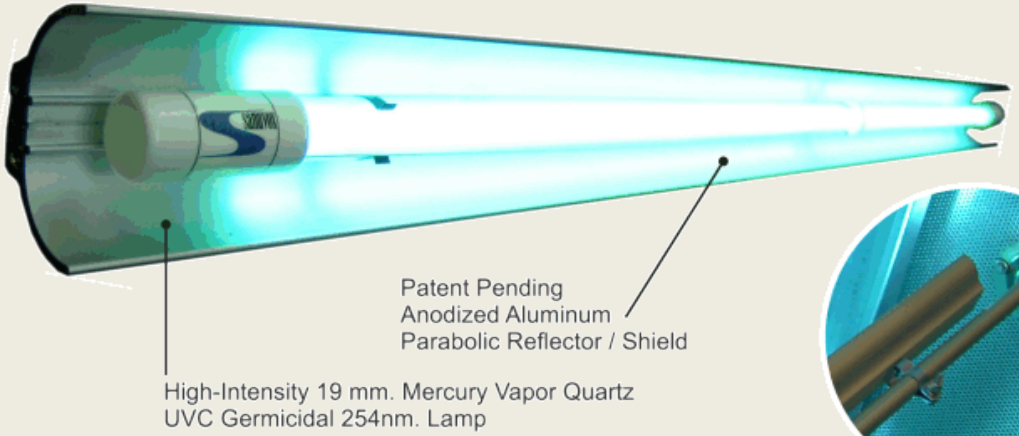
ION) RATES

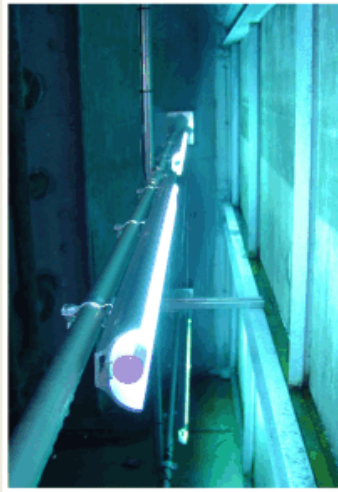
LOG
0
1
0
0

own as 100% with the corresponding
shown as 100% and the Average Log

UV Coil Clean IL

- Destroys mold and other microbial growth on the ‘Object’ as well as biological odors
- Improves energy savings & reduces coil maintenance
- High-Intensity 19mm. UVC Quartz Lamp
- Patent pending Anodized Parabolic Reflector intensifies, directs and reflects UV Energy while protecting plastics from destructive UV Rays
- University tested & published results in The Lancet Medical Journal
- Higher UV intensity & reliability than other UV Lamp / Emitters (ballast on the outside of the AHU)
- Longer warranty than competing products.
  UV Lamp: 2 years;
  Ballast: 15 years





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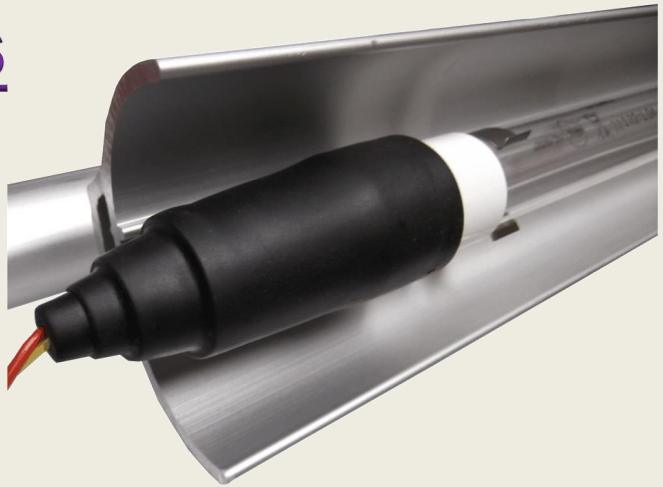
Coil Clean IL New Features

LED Status Display

Each CoilClean IL system includes an LED Status Display incorporated into each Ballast. The 3 color LED notifies the end-user on the status of the UV system and when the UV Lamp needs to be replaced.

Dry Contacts

Each UV CoilClean IL system includes a pair of Dry Contacts (NO & NC). Dry Contacts make it possible for the CoilClean ILs to be easily tied to building automation systems.

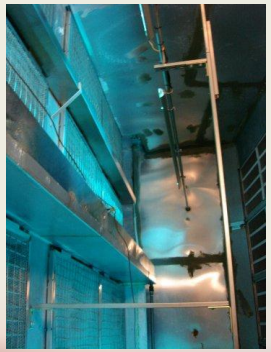


UV Lamp Boot

Each UV CoilClean system includes a UV Lamp Boot which seals the connection protecting the contacts from humidity and moisture.







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Upstream or Downstream

UV systems may be installed either UPSTREAM (return side) or DOWNSTREAM (supply side) of the evaporator coil. Either installation will keep the evaporator coil clean. (2008 ASHRAE Handbook HVAC Systems & Equipment. Chapter 16).

The two greatest factors that influence the efficiency of a UV Lamp are:

a) Lamp Cooling Effects & b) Lamp Fouling.

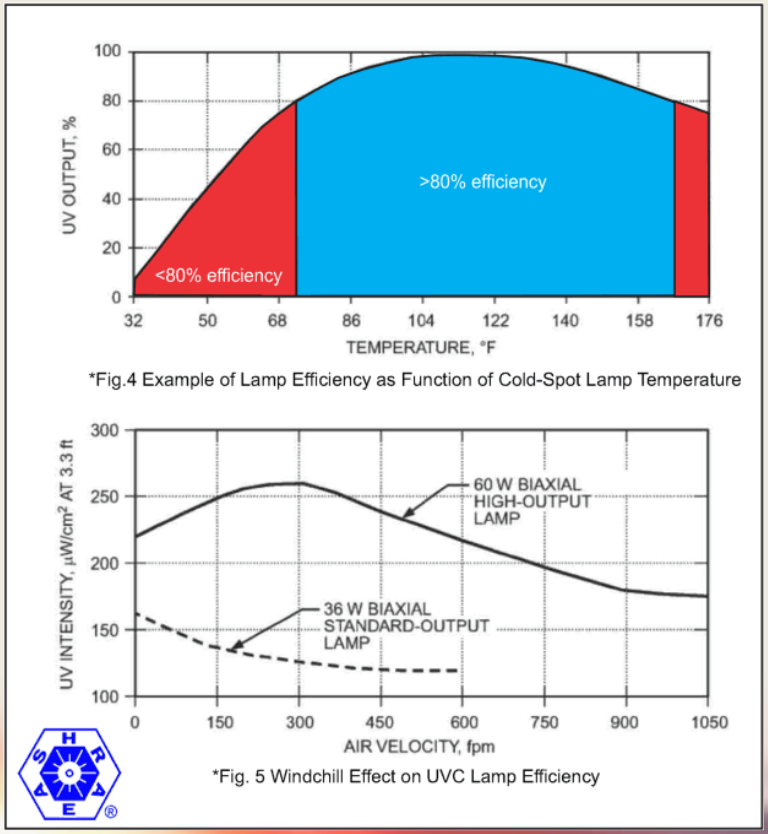

*Fig.4 Example of Lamp Efficiency as Function of Cold-Spot Lamp Temperature

*Fig. 5 Windchill Effect on UVC Lamp Efficiency

*Fig. 4 & 5 can be found in the ASHRAE 2008 Handbook chapter 16.5

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Sanuvox CoilClean Coil Irradiation

Note: Results are as at lamp changeout time (17,000 Operating Hours)

REFERENCE: Coil 140 x 96 inches UPSTREAM SIDE INSTALLATION

Installation

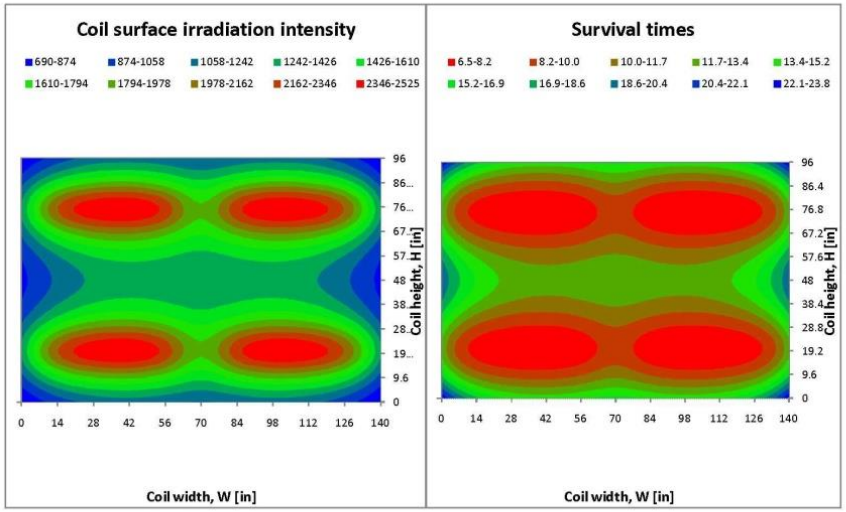
Coil Width	140 in	Lamp Position on Coil*	UPSTREAM
Coil Height	96 in	*Lamp Cooling Effects will occur on a Downstream Installation	
Distance between lamp and coil	12 in	Lamp Fouling*	NO FOULING
		*Lamp Fouling will occur on a Downstream Installation	
Lamp Length	60 in		
Number of Rows	2	Total number of lamps and fixtures required	4
Number of Lamps per Row	2	Total Power Required	589 W

Coil surface UV Irradiation Intensity

Minimum UV Irradiation Intensity	691 $\mu W/cm^2$
Average UV Irradiation Intensity	1610 $\mu W/cm^2$
Maximum UV Irradiation Intensity	2524 $\mu W/cm^2$

Survival times of ASPERGILLUS NIGER with disinfection rate of 99.9 %

Maximum survival Time	24 min
Average Survival Time	11 min
Minimum Survival Time	7 min



Sanuvox CoilClean Coil Irradiation

Note: Results are as at lamp changeout time (17,000 Operating Hours)

REFERENCE: Coil 140 x 96 inches DOWNSTREAM SIDE INSTALLATION

Installation

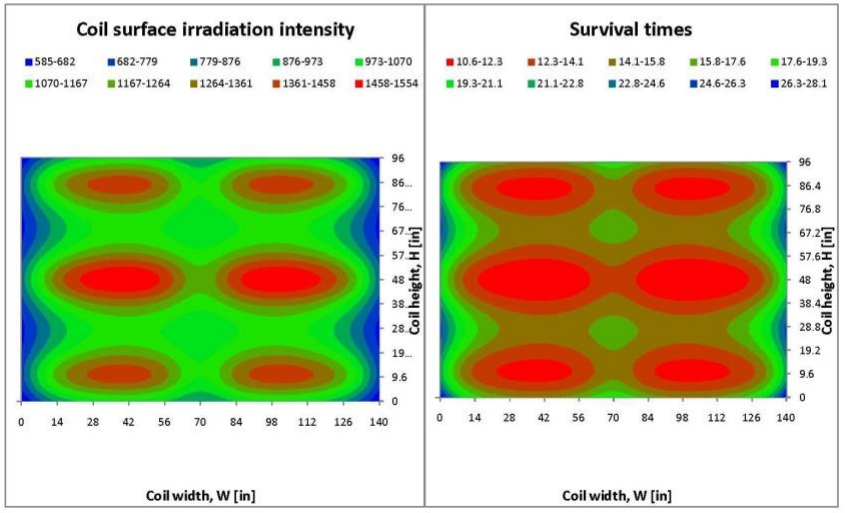
Coil Width	140 in	Lamp Position on Coil*	DOWNSTREAM
Coil Height	96 in	*Lamp Cooling Effects will occur on a Downstream Installation	
Distance between lamp and coil	12 in	Lamp Fouling*	FOULING EXPECTED
		*Lamp Fouling will occur on a Downstream Installation	
Lamp Length	60 in		
Number of Rows	3	Total number of lamps and fixtures required	6
Number of Lamps per Row	2	Total Power Required	883 W

Coil surface UV Irradiation Intensity

Minimum UV Irradiation Intensity	586 $\mu W/cm^2$
Average UV Irradiation Intensity	1127 $\mu W/cm^2$
Maximum UV Irradiation Intensity	1553 $\mu W/cm^2$

Survival times of ASPERGILLUS NIGER with disinfection rate of 99.9 %

Maximum survival Time	28 min
Average Survival Time	15 min
Minimum Survival Time	11 min



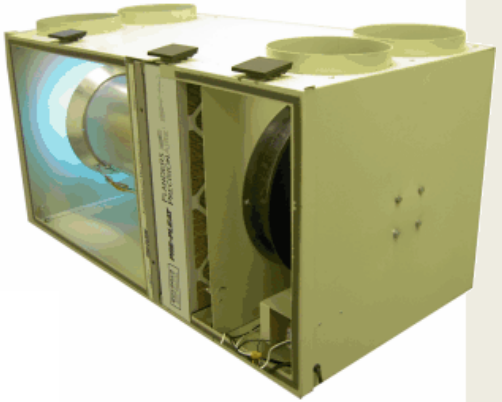
Chapter 16 of the 2008 ASHRAE Handbook states that UV lamps and fixtures can be installed on either side of the HVAC cooling coil. The size of the coil and the distance the lamps and fixtures are placed from the coil may require more lamps and fixtures when installed on the Downstream as opposed to the Upstream side. Factors such as Lamp Cooling and Fouling are taken into account when sizing on either side.

Stand-Alone Systems

P900GX PORTABLE
IDEAL FOR DAYCARE,
OFFICES, CLASS ROOMS
& BREAK-ROOMS

MB500X CEILING TILE MOUNT PURIFIER
EASILY INSTALLED INTO A DROPPED
CEILING.
QUIETLY TREATS UP TO 500 S.F.

S300FX-GX HEPA FILTER /
UV AIR PURIFIER
STAND ALONE OR DUCT MOUNTED
WITH A 200/300 CFM BLOWER



S1000FX FILTER / UV AIR PURIFIER
IDEAL FOR VOC, GARBAGE ROOMS
& SMOKING APPLICATIONS.
OPTIONAL CLEAN ROOM KIT INCL.
HEPA AND SECOND UVC LAMP

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- Illustrates that UV can solve many more issues than originally thought
- Empowers the Engineer to specify the right unit for the job
- Explain the fundamental principles involved and special attention to be given to each of the various applications

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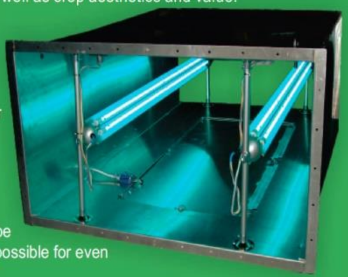
CANNABIS GREENHOUSE AIR DISINFECTION

Powdery mildew is probably one of the most common and widely distributed disease of plants in greenhouse production. This disease is responsible for significant economic losses in many greenhouse floricultural and vegetable crops. More recently, powdery mildew has been found to be a serious threat to Marijuana production. Although infections usually do not result in plant death, they reduce the yield as well as crop aesthetics and value. In the greenhouse, powdery mildew tends to be more problematic in the spring and fall when day-night temperatures favor high relative humidity but it can develop at any time during any production cycle. An understanding of the disease cycle, organisms involved, and factors that favor disease development will contribute to successful management of this disease. Experience has proven that adequate air filtration combined with UVC germicidal disinfection of the air and surfaces within the greenhouse is a powerful new way to eliminate powdery mildew outbreaks.



The Sanuvox UV Bio-Wall is the most effective in-duct air sterilization system available. The proprietary design allows for the UV assembly to be positioned parallel to the airstream guaranteeing the longest dwell-time possible for even the largest commercial AHU systems.

Features/Benefits:

* Can disinfect powdery mildew by up to 99.9% within an hour
* Sanuvox provides real time kill rates & sizing calculations
* Tested by the US EPA and National Homeland Security to destroy 99.9% of bio-contaminants on a single pass.
* Completely green cleaning method with zero residue, unlike use of fungicides and pesticides.

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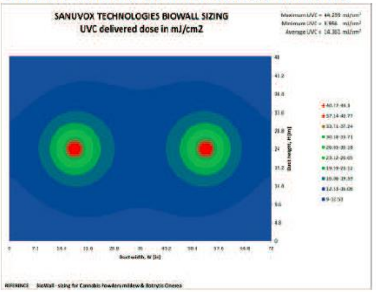
UVGI AIR STERILIZATION

OBJECTIVE: Eliminate up to 99.9% of airborne Powdery Mildew, Botrytis, and other fungus that recirculate through the ventilation system and contaminate Cannabis plants. System is designed to achieve objective every hour based on 10-12 air changes per hour.

EQUIPMENT: Bio-Wall UVC systems install in the return or supply duct parallel to the airflow with (5) high intensity UVC lamps up to 60" in length. Parallel installation allows for sufficient contact time that is required for airborne disinfection of Powdery Mildew. The proprietary disinfection sizing calculations take into account: air velocity, dimensions of the duct, the UVC lethal dose of Powdery Mildew, and the required inactivation rate. The sizing calculations determine the number and length of Bio-Wall UVC required.

STERILIZATION SIZING CALCULATIONS



SIZE INSTALLATION

SANUVOX TECHNOLOGIES BIOWALL SIZING PROGRAM

REFERENCE: BioWall - sizing for Cannabis Powdery mildew & Botrytis Cinerea

Basic Engineering Data

BIOWALL Model and number of units	Bio60	2	Unit(s)
Selected BIOWALL unit length		60	in
Duct width		72.00	in
Duct height		48.00	in
Airflow		12500.00	CFM
Air velocity in the free duct		520.83	ft/min
Air velocity at BioWall section		525.67	ft/min
Pressure drop at Biowall installation point		0.0009	in H2O
Total power consumption		1773	W
Air temperature increase due to BioWall system		0.25	°C
AVG APPLIED Germicidal UV dose to the air stream		14361	µJ/cm2

RECIRCULATION* INACTIVATION (STERILIZATION) RATES

	Minimum	Average	LOG Average
Powdery Mildew	100.00%	100.00%	6
Botrytis cinerea	99.93%	100.00%	4
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A 4 log inactivation equals 99.99%. An inactivation rate that is greater than 99.99% is shown as 100% with the corresponding Average Log Reduction. For example an Average Inactivation Rate of 99.9992% would be shown as 100% and the Average Log reduction would be 5.

*Recirculation Inactivation Rate is calculated after 8 passes. The inactivation rate increases marginally after 8 passes

SANUVOX TECHNOLOGIES BIOWALL SIZING PROGRAM

NOTE: RESULTS ARE AS AT LAMP CHANGEOUT TIME (17,000 OPERATING HOURS)

Data is to be entered in GREEN BOXES ONLY. Click on the GREEN BOX for any Drop Down Menues. When Data Entry is complete, click on the CALCULATE Button

REFERENCE: BioWall - sizing for Cannabis Powdery mildew & Botrytis Cinerea

Input parameters

	English unit	Metric unit
Airflow	12500 CFM	5.90 m³/s
Air velocity	520.8 ft/min	2.65 m/s
Air velocity at Biowall	525.7 ft/min	2.67 m/s

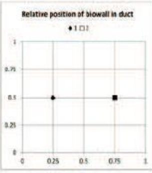
Duct: rectangular

Width	72 in	1.8288 m
Height	48 in	1.2192 m
Area		2.229673 m²

Installation

Number of biowalls: 2

Relative position of each biowall (from 0.1 to 0.9)	X	Y
Biowall no. 1	0.25	0.5
Biowall no. 2	0.75	0.5



Sanuvox Model: Bio60

Lamp length	60 in	1.524 m
Lamp arc length	57 in	1.4478 m
Lamp diameter	19 mm	0.019 m
Extrusion Diameter	4.5 in	0.1143 m
Power per lamp (rated)		164.3 W
Power per length	2.74 W/in	107.8 W/m
Power per surface area	190.1 mW/cm²	1901.2 W/m²
UVC power per surface area	59.9 mW/cm²	598.9 W/m²
UVC efficiency		31.5 %
UVC power per lamp		51.75 W
UVC power per length		35.75 W/m
Number of lamps		5
Total UVC power		258.8 W
Total input power		886.5 W

Lamp aging factor	90 %
Duct wall reflection	85 %
Temperature correction factor	1

Other constants

Air density @20C	1.204 kg/m3
Air specific heat @20C	1005 J/kg.K

Sanuvox has increasingly proven that UVC Air Treatment has become the most effective, economical and adaptable system available for the disinfection of airborne powdery mildew, molds and fungus within a Cannabis growing facility.

SANUVOX

Make-Up Air: Odors & Bio-Contaminants

It is not uncommon for outside contaminants including odors and allergens to find their way migrating into a building. Restaurant odors, manufacturing off-gassing, diesel fumes from idling trucks even jet fuel from helipads can be pulled into the make-up air and distributed throughout the HVAC system and building.

Sanuvox Technologies' line of in-duct UV air treatment systems are the ideal solution for these often troublesome issues. Sanuvox offers exceptionally cost-effective systems that can address IAQ issues that filters and absorption media cannot.

***UV Bio-Wall QUATTRO** *Shown here*
***UV Bio-Wall In-Duct Air Treatment System** **Available*

Features

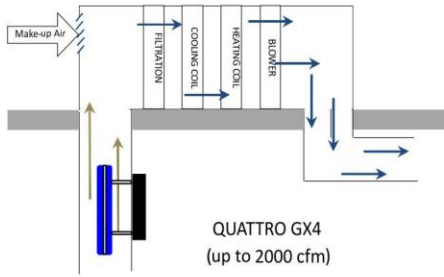
- *Sanuvox proprietary system eradicates biological contaminants such as mold, bacteria, viruses, germs & allergens*
- *Reduces chemicals, VOCs & biological odors*
- *Installed PARALLEL to the air-stream results in greater 'Dwell Time' between the air & the UV Lamps*

EXTERIOR ODORS

OBJECTIVE: Substantially reduce odors introduced into the workspace (offices) due to the supply of contaminated "fresh" a from outside. For example: odors from restaurants, factories, diesel engines, sewage, etc. that are drawn into the building b the HVAC fresh air intake.

EQUIPMENT: Duct mounted units installed in the return or supply side of the HVAC system parallel to the airflow and supplied with multiple Germicidal UVC lamps, each with a section of Oxidizing UVV that can be covered or uncovered depending on the concentration of odors.

Typical installation on the HVAC return's side



OPERATION: The UV lamps treat the recirculating air in two ways:

1. The g ermicidal UVC section destroys airborne biological contaminants (viruses, bacteria, mold).
2. The oxidizing UVV section of the l amp reduces the chemical components in the air through photo-oxidation. Select units are designed to be "dosed" on site, such as the QUATTRO GX4.

GENERAL: SANUVOX™ PROCESS ON BIOLOGICAL AND CHEMICAL CONTAMINANTS

1-ACTIVATION PHASE $O^2 + O^* \rightarrow O^* + O^*$

Ultraviolet photon energy (170 -220nm) is emitted from a high -intensity source to decompose (break -down) oxygen molecules into activated monoatomic oxygen. The rate of production or effectiveness of this process depends on the wavelength and intensity of its source.

2-REACTION PHASE: $O^* + P \rightarrow PO$

The activated oxygen atoms (O*) are then mixed in the airstream; the process will react with any compound containing carbon-hydrogen or sulfur, reducing them by successive oxidation to odo rless and harmless by -products. If airborne contaminants are outnumbered by the activated oxygen atoms, then there will be formation of residual ozone (O^3) which wi occur following the oxidation of normal oxygen molecules (0^2).

3- NEUTRALISATION PHASE: (also GERMICIDAL) $O^3 + UV(C) \rightarrow O^2 + O^*: O + O \rightarrow O^2$

CHEMICAL DECOMPOSITION:

- Formaldehyde $CH_2O + O^* \rightarrow CO_2 + H_2O$
- Ammonia $NH_3 + O^* \rightarrow N_2 + H_2O$
- Styrene $C_8H_8 + O^* \rightarrow CO_2 + H_2O$
- Mercaptans $H_2S + O^* \rightarrow SO_2 + H2O$

ADVANTAGES

- Odors in the workplace are substantially reduced
- Low maintenance
- Lamp replacement 1-2 years
- Improved indoor air quality (IAQ)

TARGETS

- Buildings near Airports & Helipads
- Buildings with adjoining
  - Warehouse (diesel)
  - Printing shop, restaurants, etc.
  - Mechanical workshop
- Crematorium

Garbage Rooms / Noxious Areas

Facilities, apartments and condominiums often suffer from odors migrating from the garbage room to other parts of the building. It is not uncommon for garbage room odors to be pulled from the holding area and distributed up the elevator shaft or into the HVAC system.

The Sanuvox S300FX equipped with a Remote Oxidation Control will automatically tailor the amount of oxidation for each application destroying bio-chemical contaminants that are so troublesome for garbage rooms.

S300FX w/ Remote Oxidation Control System

Features

- *Reduce odors & chemicals*
- *Destroy biological contaminants & biological odors*
- *Stand-Alone / Wall-Mount / Duct-Mount*
- *Remote Oxidation Control System (OCS) monitors residual ozone levels and controls the secondary Booster Oxidation Lamp (UVV) to maintain ozone levels at .025 ppm*

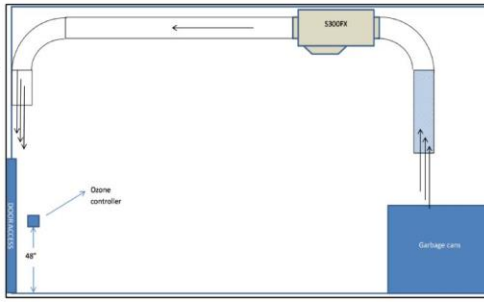
GARBAGE ROOMS

OBJECTIVE: Re-circulate the air in a garbage/trash room to reduce odors and bacteria while maintaining and monitoring the oxidation process.

EQUIPMENT: Stand-alone UV air purifier that incorporates a blower of either 300 or 1000 cfm, filters to capture particulates, one dual zone UVC/UVV lamp & one oxidizing UVV lamp, the latter controlled by an ozone detector set to a max ozone concentration level of 0.025

OPERATION: Untreated air is drawn into the unit from the top of the garbage cans or containers and treated by the UV germicidal and oxidizing lamps. The treated air is exhausted above the entrance to the room, creating a curtain of clean air, insulating the room. The ozone controller samples the air every 70 seconds and will shut off the oxidizing lamp should the ozone concentration level exceed 0.025 ppm.

TYPICAL INSTALLATION
S300FX-GX & SUBKITOZDS300



SIZING: Approximately 6 to 8 air changes per hour are required.

- A **P900X-SP** unit with an all UVV lamp will be required for an 800 cu ft room (10' X 10' X 8'). Since there is no ozone controller, the UVV lamp will be manually covered with foil for an acceptable ozone concentration.
- An **S300FX-GX** unit (300 cfm) will be required for a 2400 cu ft room (15' X 20' X 10'). This relates to 6 air changes per hour. Factory installed accessory (**SUBKITOZDS300**) is also required.
- An **S1000FX-GX** unit (1000 cfm) will be required for a 9600 cu ft (24' X 40' X 10'). This relates to 6.25 air changes per hour. Factory installed accessory (**SUBKITOZDS1000**) is also required.

MAXIMUM OZONE CONCENTRATION LEVELS

Agencies/ Concentration exposure limit	1 hour	8 hours	24 hours	1 year
City of Montreal	0.082 ppm	0.038 ppm	0.025 ppm	0.015 ppm
Environment Canada		0.065 ppm	0.025 ppm	
Health Canada	0.120 ppm			
EPA (USA)	0.120 ppm	0.080 ppm		
OSHA	0.300 ppm (15 min)	0.100 ppm		
WHO		0.050 ppm		
ACGIH		0.050 to 0.100 ppm		
NIOSH (IDLH 5 ppm)	0.100 ppm			

BENEFITS

- Substantially reduces odors
- Low maintenance
  - Lamp replacement 1-2 years
  - Periodic filter replacement
  - Controller Recalibration not required for 3 years
- Low cost compared to refrigeration (for odor control)

MARKETS

- Condos with garbage chutes
- Public buildings with restaurants
- Hotels and meeting rooms
- Sports centers or amusement parks

Smoking Rooms & Tobacco Smoke

Designated smoking areas although typically separated from working and living areas often cause problems with air that may very well circulate in and out of the designated areas. The smoking area itself may be overwhelmed with cigarette smoke causing smokers to seek alternative areas to smoke.

Sanuvox Technologies offers two UV / Filter stand alone / ducted models that are effective at removing tobacco smoke from the air and reducing odors as well as nicotine and smoke which is so problematic in these applications.

S300FX-GX UV / Filter System (200/300 CFM) **Available*
S1000FX-GX UV / Filter System (1000 CFM) ***Shown here*

Features

- *Unlike conventional technology, Sanuvox UV systems do not use costly carbon for absorption, or rely solely on filters which easily become coated with tar & nicotine*
- *The Sanuvox UV process changes the molecular structure of the tobacco smoke into a fine power which is then easily captured on the filter media*
- *It is recommended that the UV systems are sized to provide a re-circulation rate of 6-8 air changes per hour*

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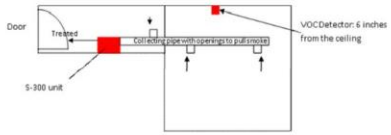
SMOKING ROOMS

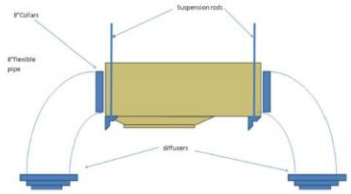
OBJECTIVE: To re-circulate the air in a room where there are varying numbers of smokers, reducing odors, nicotine and smoke. Equipment producing 6-8 air changes per hour is required.

EQUIPMENT: Stand-alone 300 or 1000 cfm air purifiers that will include germicidal and oxidizing ultraviolet lamps, pre-filters and main filter to capture the nicotine and smoke. An optional VOC (Volatile Organic Compound) detector can be used with optional multiple lamps when the number of occupants increases.

OPERATION: Sanuvox Dual Zone UV lamp will reduce odors, nicotine and smoke in the air in the room through recirculation. With the optional UVV lamp(s) and VOC detector, if the smoke level increases (more smokers), the VOC detector will trigger the additional oxidizing lamp(s), then shut them off when the level decreases. The cycle is repeated, lowering the odor, nicotine and smoke levels, until the maximum reduction is reached.

TYPICAL INSTALLATION





GENERAL

Cigarette smoke is composed mainly of:

- White ash
- Nicotine molecules
- Chemical by-products

Ash will be trapped by the pre-filters.

Nicotine will be transformed into a type of yellow powder that will be captured by the pre-filters and the main filter.

The chemical by-products will be oxidized by the UV process: high frequency UVV energy activates the organic molecules and accelerates the chemical reaction, resulting in the air being oxidized.

Odors are oxidized by the process of photolysis that initiates the breaking of chemical bonds by the action of the ultraviolet light. The oxidation process will reduce odors and chemical contaminants by changing the complex molecular contaminants into CO_2 and H_2O

SIZING: Approximately 6 to 8 air changes per hour are required. This reduces the standard of fresh air required by two thirds.

- An S300FX-GX unit (300 cfm) will be sufficient for a 1920 cu ft room (12' X 20' X 8') – 9.3 changes per hour- Optional factory installed accessories (SUBKITVOCS300)
- An S1000FX-GX (1000 cfm) will be sufficient for a 9600 cu ft room (20' X 40' X 10') – 7.5 changes per hour - Optional factory installed accessories (SUBKITVOCS1000)

BENEFITS

- Reduced Odors and Smoke
- No tar buildup in the unit - UV irradiation crystallizes the nicotine molecules
- Low maintenance -
  - Lamp replacement 1-2 years
  - Periodic filter replacement

MARKETS

- Eldercare homes
- Private homes
- Poker rooms / Casinos
- Bingo halls
- Cigar bar
- Smoking Rooms

Locker Rooms & Lavatory Odors

Locker Room odors are the result of perspiration which is excreted by the sweat glands in our skin. Sweat itself is not the source of the odor, but rather the off-gassing of the bacteria which feeds on sweat. The source of this unpleasant off-gassing can be found on occupants, clothes, towels and equipment as well as other soft materials.

Sanuvox Technologies' S300FX-GX UV / HEPA System is the ideal solution to reduce & eliminate unpleasant odors such as locker room and lavatory odors. The proprietary Sanuvox process will sterilize and oxidize bacteria, viruses, chemicals and odors dramatically improving the air quality in these sensitive applications.

S300FX-GX UV / HEPA System

Features

- *Pre-filter & HEPA filter captures particles down to 0.3 microns in size*
- *Sanuvox proprietary system eradicates biological contaminants such as mold, bacteria, viruses, germs & allergens*
- *Reduce chemical & biological odors*
- *Can be used as a stand-alone, wall-mount or HVAC duct-mount system*
- *Two speed 200/300 CFM system*

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LOCKER ROOMS

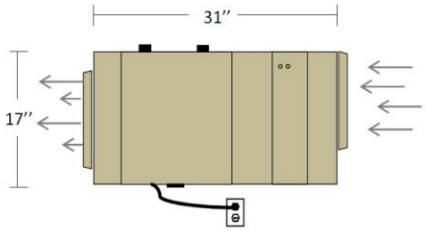
OBJECTIVE: Reduce odors resulting from perspiration and sweat in locker rooms by killing bacteria and decreasing VOC chemical concentrations to achieve better air quality.

EQUIPMENT:

Stand-alone: Model P900 equipped with a blower of 80 cfm; Model S300 with a blower of 300 cfm or Model S1000 with a blower of 1000 cfm. Filters (except P900) to capture particulates, (pet hair, etc.) and a dual zone UVC/UVV "adjustable" lamp are standard. The S300 unit can be used as stand-alone system with optional intake and exhaust louvers or ducted using an 8-inch flexible duct with optional collars.

OPERATION: Untreated air is drawn into the inlet of the unit, purified with the germicidal/oxidation UV lamp, filtered and then exhausted. Recirculating the air in the room continuously reduces bacteria and odors, improving overall air quality.

WALL INSTALLATION: S300FX-GX with MSCLOU1



SIZING:

Approximately 6 to 8 air changes per hour are required.

- A **P900-GX SP** unit (80 cfm) w/ a dual zone UVC/UVV lamp will be required for a 1,200 cu ft room, (15' X 10' X 8').
- An **S300FX-GX** unit (300 cfm) w/ a dual zone UVC/UVV lamp will be required for a 4,500 cu ft room, (25' X 20' X 10'). Collars (MSCCOL1) can be ordered to duct the unit using an 8 inch diameter duct, or an intake and exhaust louver grill(s) (MSCLOU1) can be ordered if the unit will be used as a stand-alone system.
- An **S1000FX-GX** unit (1000 cfm) w/ a dual zone UVC/UVV lamp will be required for a 15,000 cu ft. room, (50' X 20' X 15'). The system uses 2 x 8 inch inlets and 2 x 8 inch exhaust outlets (collars).

Unit should be positioned near the center of the room to be as effective as possible. Excluding the P900GX unit, all other units can be installed in the plenum above the ceiling or in an adjoining room and ducted with 8 inch round duct.

FEATURES:

All Sanuvox air treatment systems are equipped with a dual zone "J" UVC/UVV lamp. All Dual Zone lamps have a maximum oxidizing UVV section in order to minimize residual ozone. In situations where odors are more concentrated, it is possible to outfit the units (except unit P900-GX) with special lamps incorporating a larger section of oxidation, with the installer making the final odor adjustments on the job site.

For more details on any of these units or their operation, please contact your Sanuvox representative.

ADVANTAGES

- Greatly reduced odors
- Low maintenance
  - Lamp replacement every 2 years
  - Periodic filter replacement
- Improved indoor air quality (IAQ)

MARKETS

- Sporting (Hockey, Football, Soccer, etc.) team dressing room, fitness centers, etc.
- Laundry rooms
- Dirty laundry storage
- Basement odors, mold odors, heating oil odors

Shelter / Kennel / Veterinarian Air Sterilization

Illness among animals especially dogs can be significantly higher when so many are boarded within close proximity or kept within the same room or building. Airborne illness can easily be transmitted from one animal to another. Odors may very well cause issues all of their own when odors migrate to other areas or cause issues for staff and visitors.

Sanuvox Technologies' UV systems are the ideal solution for destroying airborne viruses and bacteria as well as reducing the concentration of unpleasant odors.

***UV Bio-Wall QUATTRO** *Shown here*
***S300FX-GX UV / HEPA System** **Available*

Features

- *Sanuvox proprietary system eradicates biological contaminants such as bacteria, viruses, germs & allergens*
- *Destroys chemicals & biological odors*
- *Multiple application UV systems can be used for both stand-alone and duct-mount installations*

*

SANUVOX ANIMAL KENNEL, SHELTER

OBJECTIVE: Substantially reduce odors such as ammonia produced by animals in kennels, shelters, pet stores and veterinarian clinics and sterilize the air to reduce the risk of airborne viral & bacterial infection between animals.

EQUIPMENT:

1. **Stand-alone**: Model P900 equipped with an 80 cfm blower; Model S300 with a 300 cfm blower or Model S1000 with a 1000 cfm blower. P900 & S300 are equipped with filters to capture particulates, (pet hair etc.). A dual zone UVC/UVV lamp is standard. An "adjustable" oxidizing lamp is available.
2. **In-Duct** QUATTRO GX4 unit installed parallel to the airflow includes four UVC/UVV lamps, each with a one-inch section of oxidizing UVV. Two of the lamp's oxidizing sections are masked with removable foil, allowing for increased oxidation if necessary.

TYPICAL INSTALLATIONS

OPERATION: Each unit treats the air through recirculation in two ways:

1. The Germicidal UVC lamp portion destroys airborne biological contaminants (viruses, mold, bacteria.)
2. The Oxidizing UVV lamp portion reduces airborne chemical contaminants & VOCs through photo-oxidation.

GENERAL: SANUVOX™ PROCESS ON BIOLOGICAL AND CHEMICAL CONTAMINANTS

1-ACTIVATION PHASE $O^2 + O^* \rightarrow O^* + O^*$

Ultraviolet photon energy (170-220nm) is emitted from a high-intensity source to decompose (break down) oxygen molecules into activated monoatomic oxygen. The rate of production or effectiveness of this process depends on the wavelength and intensity of its source.

2-REACTION PHASE: $O^* + P \rightarrow PO$

The activated oxygen atoms (O^*) are then mixed in the airstream; the process will react with any compound containing carbon-hydrogen or sulfur, reducing them by successive oxidation to odourless and harmless by-products. If airborne contaminants are outnumbered by the activated oxygen atoms, there will be formation of residual ozone (O^3) which will occur following the oxidation of normal oxygen molecules (O^2).

3- NEUTRALISATION PHASE: (also GERMICIDAL) $O^3 + UV(C) \rightarrow O^2 + O^*: O + O \rightarrow O^2$

CHEMICAL REACTION

- Ammonia $NH_3 + O^* \rightarrow N_2 + H_2O$

BENEFITS

- Indoor odors greatly reduced
- Reduce cross-contamination between animals
- Improved air quality
- Low maintenance

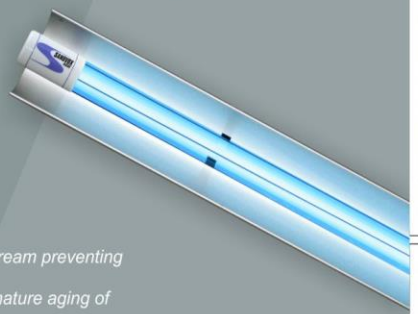
MARKETS

- Kennels, pet boarding and animal shelters
- Laboratories
- Veterinarian Centers
- Zoos and pet stores

Cold Room Air Sterilization & Ethylene Reduction

Mold and bacteria can severely impact the quality of meat, chicken, fish, fruits & vegetables that may be stored or prepared in warehouses and cold rooms. Ethylene off-gassing cause fruits and vegetables to prematurely ripen & age, dramatically shortening shelf-life.

Sanuvox UV CoilClean IL systems are installed facing the cooling coil and designed to bask the coil and air with ultraviolet energy destroying microorganisms including bacteria, mold and viruses while oxidizing & reducing ethylene off-gassing.



Sanuvox UV CoilClean IL Muti-split

Features

- *Patented Sanuvox process sterilizes the cooling coil and airstream preventing and destroying bacteria, mold & viruses*
- *Destroy ethylene off-gassing which is a leading cause of premature aging of fruits & vegetables*
- *Easily retrofitted into pre-exhisting systems*
- *Available in lengths from 12" to 60"*

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COLD ROOMS

OBJECTIVE: Destroy airborne bio-chemical contaminants such as bacteria, viruses & mold that may affect the storage and preparation of fish, chicken and meat. Destroy ethylene off-gassing which causes produce to ripen faster extending shelf-life.

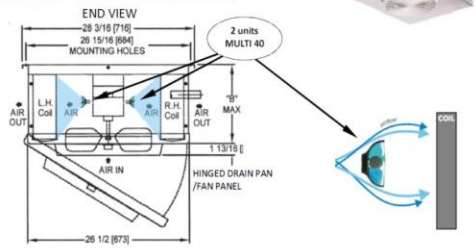
EQUIPMENT: IL MULTISPLIT units installed facing the cooling coils in the fan coil unit. Each IL unit includes a UVC /UVV lamp mounted in an anodized aluminum parabolic reflector. The ballast box incorporates LED status lights for providing lamp status & replacement (2 yrs.) and can be remotely monitored.

TYPICAL INSTALLATION

OPERATION: The fan coil unit recirculates the air, where:

1. The UVC germicidal section of the UV lamp destroys airborne biological contaminants (viruses, mold, bacteria and spores)
2. The UVV oxidizing section of the UV lamp reduces ethylene, slowing down the ripening process of vegetables and fruits.

Coils remain clean, more energy efficient



SLOWING DOWN THE CONTAMINATION SPREAD WITH UVC

Produce will degrade due to the rotting process. Rotting is caused by parasitic fungi and mold. Food deterioration begins with the breakdown of the cellular tissue by enzymatic action that allows the growth of microbes. Germicidal UV (UVC) is extremely effective at preventing the reproduction of bio-contaminants. UVC destroys airborne fungi, molds and their spores, limiting the contamination spread from one fruit to another. Meat, fish & chicken are especially vulnerable to airborne bio-contamination. UVC sterilizes the air destroying contaminants as they circulate within the cold room.

RETARDING THE RIPENING PROCESS WITH UVV

Photo-oxidation with UVV can be used to reduce chemicals that trigger the ripening of fruits and vegetables. The life stages of a plant are influenced by plant hormones. An organic compound involved with ripening is ethylene, a gas created by plants from the amino acid, methionine.

Ethylene increases the intracellular levels of certain enzymes in fruit and fresh-cut products, which include:

- Amylase, which hydrolyzes starch to produce simple sugars, and
- Pectinase, which hydrolyzes pectin, a substance that keeps fruit hard.

UVV oxidizes and thus neutralizes the ethylene molecules released by the ripening process, slowing down the spread of ripening to the surrounding produce.

This oxidation process breaks down ethylene into carbon dioxide and water vapor.

Ethylene C_2H_4 $\quad C_2H_4 + O^* \rightarrow CO_2 + H_2O$

BENEFITS

- Extended shelf life for vegetables and fruits
- Sterilize airborne bacteria, viruses & mold
- Cleaner cooling coils - more energy efficient
- Low maintenance -
  - Lamp replacement every 2 years
  - 15 years ballast warranty

MARKETS

- Cold storage rooms, groceries
- Meat, fish & chicken storage & preparation facilities
- Fruit and vegetable retailers
- Fruit and vegetable warehousing
- Fruit and vegetable transportation

Fruit & Vegetable Surface Sterilization

Surface contamination of fruits & vegetables is a problem for growers, distributors and retailers. Mold and bacteria can have severe effects causing produce to spoil.

FoodSafe UV Sterilizers are exceptionally safe & versatile disinfection systems for surface, packaging & conveyor applications designed to bask meat, fish & poultry, fruits & vegetables, baked goods and packaging with UVC germicidal light. The UV system is extremely effective at destroying surface contamination while extending product shelf-life. Only a few seconds of exposure can achieve up to a 99.999% destruction of common biological contaminants that are problematic in the food industry.

FoodSafe IL UV Surface Sterilization

Features

- *Incorporate UV fixtures into the production line (i.e. over conveyer belts) to bask the products and surfaces prior to packaging maintaining a sterile product ready for distribution and consumption*
- *Surface sterilization of meat, fish & poultry, fruits & vegetables, baked goods and packaging*
- *Easily incorporates into pre-existing sorting, manufacturing and packaging equipment*
- *All FoodSafe IL UV Lamp systems are TEFLON® coated to insure that no UV Lamp contents will escape in the event of Lamp breakage*

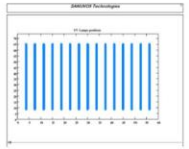
PRODUCE DISINFECTION

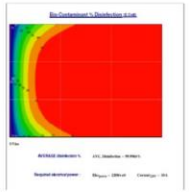
OBJECTIVE: Prevent & destroy microbial contamination such as bacteria and fungi that occur naturally on fruit and vegetable surfaces, and are responsible for premature decay. The process will leave no residue as is found using chlorine or irradiation treatments with gamma rays. At the producer level, sterilization of fruits and vegetables could reduce the use of pesticides.

EQUIPMENT: FoodSafe IL units in various widths, equipped with parabolic reflectors and Teflon coated lamps will be positioned equidistant across the conveyer, parallel to the conveyor. Computerized sizing programs taking into account the speed of the conveyer and the contaminant(s) to be treated will determine the size of the lamps.

OPERATION: The end user will determine the location and design of the lamp assembly enclosure that will attach to the conveyer guaranteeing there is no direct UV exposure to employees. Fruits and/or vegetables will be exposed for a predetermined period of time to UV radiation as they move through the enclosure on the conveyor. This predetermined time will be sufficient to sterilize the fruit and/or vegetable pathogens and slow down ripening process.

TYPICAL INSTALLATION





Pictured here a Sanuvox UV installation for surface sterilization of Bell peppers

RESEARCH ON STRAWBERRIES

Researchers from the Department of Food, Science and Nutrition (Laval University, Quebec, Canada) demonstrated that exposing strawberries to ultraviolet radiation prolongs their shelf life. Freshly picked strawberries exposed to Germicidal Ultraviolet Irradiation (UV-C) have retained their freshness for 14 to 15 days, while untreated freshly picked strawberries were “almost done” on the tenth day.

The conclusions from this research have been published in the Food Science Journal. Refrigeration, which slows the growth of microorganisms and fruit ripening, allows a limited but effective mean regarding conservation of strawberries.

"Exposure to UV-C is a very interesting approach to facilitate the marketing and distribution of fresh fruits and vegetables", says researcher Joseph Arul. This treatment slows the ripening of strawberries: they remain firm longer, their respiratory rate is lower, their color is more attractive and the taste is not altered. "It is believed that exposure to UV-C would kill some mold on the surface of the fruit or, more likely, the treatment would stimulate the defense mechanisms of the produce," suggests the researcher.

Arul's team has already demonstrated the benefits of UV-C exposure for the conservation of **carrots, broccoli, tomatoes** and **blueberries.**

Arul does not anticipate negative reactions from consumers, unlike gamma irradiated food, or more recently, genetically modified organisms. "The technique is more acceptable to a consumer. In low doses, UV is beneficial. It is a light source and I do not think people have problems with that."

BENEFITS

- Complete sterilization without pesticides
- No residue, no visual change of vegetables
- Increased shelf life
  Low maintenance - lamp replacement every 2 years
- Teflon covered lamps - in case of breakage, broken glass & contents remain inside the Teflon sleeve

MARKETS

- Vegetable Growers
- Fruit and vegetable importers
- Hydroponic producers
- Value-added packagers

SANUVOX

QUESTIONS?

SANUVOX TECHNOLOGIES

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Thank You!