Introduction: Light Progress

- Founded in 1987
- Branches in Germany & USA
- 1,000’s of Installations
- Over 400 Individual Products
- High Quality Materials
- Science-Based Approach

UV Disinfection:

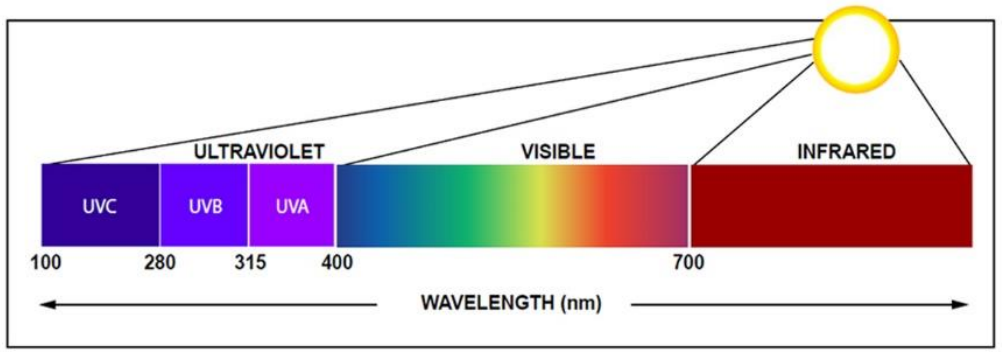
International bodies and organizations recommend the use of UV-C radiation for air treatment.

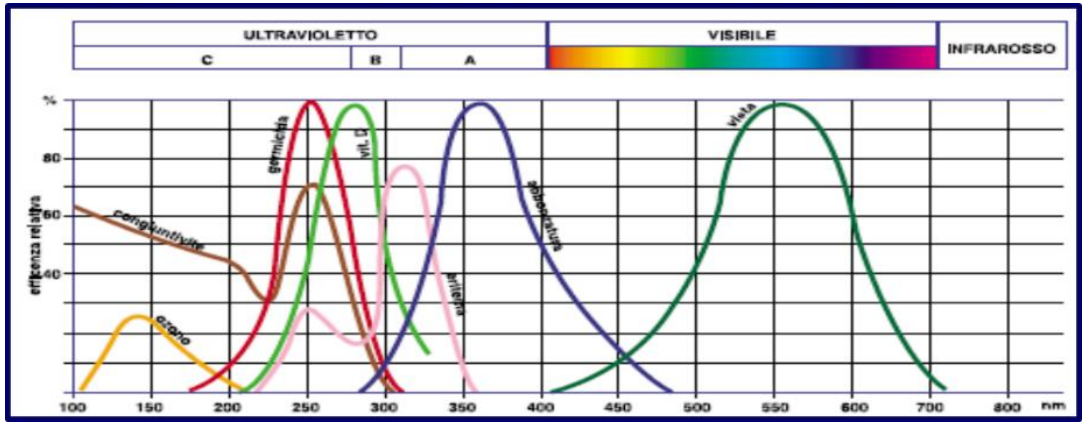
For decades, many world-class institutions and organizations such as WHO, EPA, CDC, ASHRAE have been recommending the use of UV-C radiation for disinfection of water, rooms and HVAC systems.

The use of UV-C radiation is also indicated for the prevention of Coronavirus Sars-Cov-2 and, following the recent COVID-19 pandemic, the concept of using UV sections within the HVAC system as a solution to contain the spread of the virus has been successfully introduced.

***October 5th 2020, CDC Guidance – "The principal mode by which people are infected with SARS-CoV-2 (the virus that causes COVID-19) is through exposure to respiratory droplets carrying infectious virus."**

UV Disinfection:





Light in a broad sense can be divided in visible, infra-red and ultraviolet rays.

Ultra-violet rays (invisible) can be classified in :

UV - A (with tanning properties)

UV - B (with therapeutic properties)

UV – C (with germicidal properties)

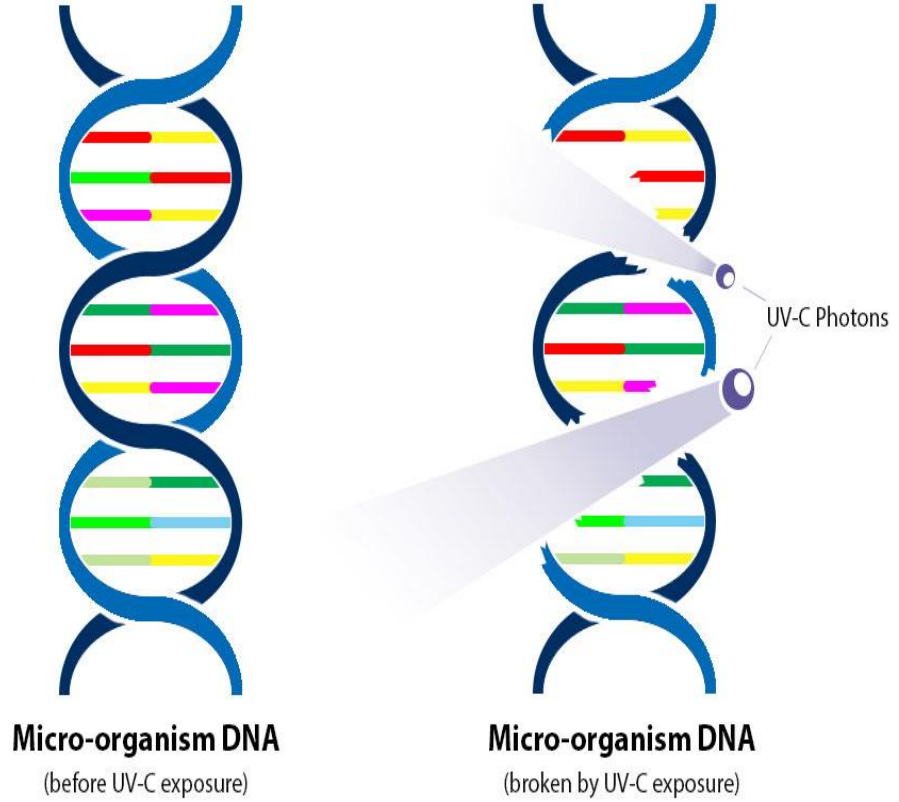
UV Disinfection:

What does UVGI mean?

The absorption of a UV photon by the DNA of microorganisms causes a destruction of a link in the DNA chain, and consequently the inhibition of DNA replication.

The germicidal effects of the UV-C radiation destroy DNA of Bacteria, Viruses, Spores, Fungi, Molds and Mites avoiding their growth and proliferation.

UVGI technology is a physic disinfection method with a great costs/benefits ratio, it's ecological, and, unlike chemicals, it works against every microorganisms without creating any resistance.



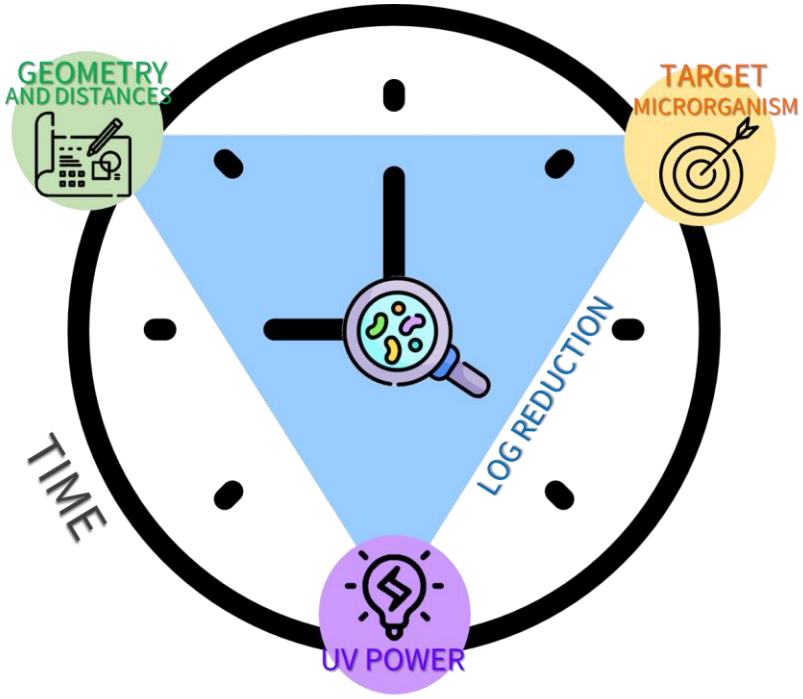
UV Disinfection:

Each microorganism has a specific UV-resistance threshold, called DOSE. The specific dose need to be delivered to get a proper disinfection level, which is expressed in LOG REDUCTION (1 Log=90%, 2 Logs=99%, 3 Logs=99,9%, etc).

Therefore, for some microorganisms a low level of UV POWER is sufficient to be eliminated, while for others it takes more power to get same elimination level...or alternatively a longer exposure TIME.

These factors are essential to understand UV technology:

- Disinfection level that needs to be achieved (Log Reduction);
- Target pathogen (and its dose);
- UV power in play;
- Exposure time / geometry and distance balance;

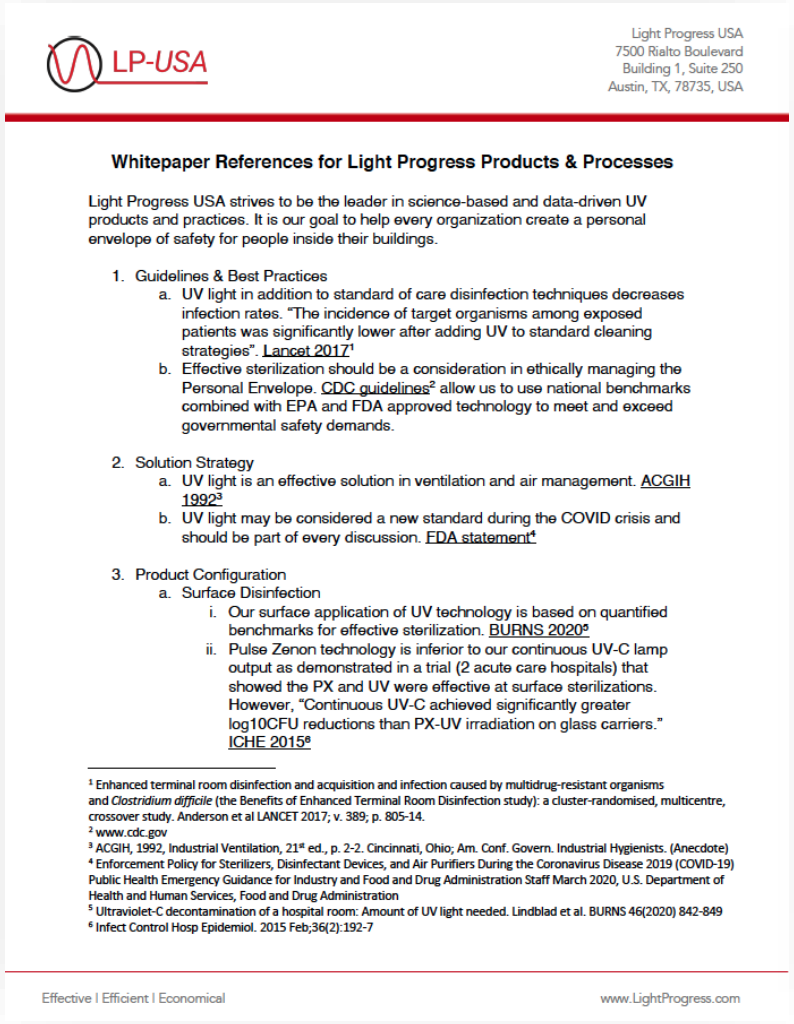


UV Disinfection:

UV DOSE needed to eliminate 99% (2 Logs) value in (µW/cm2 SEC)

BACTERIA		Virus (genieric, DNA e RNA)	
Mycobacterium tuberculosisn (TBC)	4300	Virus dell' influenza A	4558
Escherichia coli ATCC 11229	4800	Hepatitis A HM175	8000
Legionella pneumophila ATCC 33152	3200	Corona Virus (SARS-CoV1 – MERS-Cov)	1200-1500
Pseudomonas aeruginosa ATCC 9027	6500	Rotavirus	15000
Salmonella ATCC 6539	4500	Molds	
Staphylococcus aureus	3200	Aspergillus Amstelodami	66700
Streptococcus hemolyticus	4400	Aspergillus Brasiliensis (Niger)	226000
Vibrio cholerae	4100	Yeasts	
MRSA	6550	Comuni lieviti dolciari	12000
Clostridium Difficile	10000	Lievito di birra	20000

Scientific Evidence: Solution & Product Support



LP-USA

Light Progress USA
7500 Rialto Boulevard
Building 1, Suite 250
Austin, TX, 78735, USA

Whitepaper References for Light Progress Products & Processes

Light Progress USA strives to be the leader in science-based and data-driven UV products and practices. It is our goal to help every organization create a personal envelope of safety for people inside their buildings.

1. Guidelines & Best Practices
   a. UV light in addition to standard of care disinfection techniques decreases infection rates. "The incidence of target organisms among exposed patients was significantly lower after adding UV to standard cleaning strategies". Lancet 2017[1]
   b. Effective sterilization should be a consideration in ethically managing the Personal Envelope. CDC guidelines[2] allow us to use national benchmarks combined with EPA and FDA approved technology to meet and exceed governmental safety demands.

2. Solution Strategy
   a. UV light is an effective solution in ventilation and air management. ACGIH 1992[3]
   b. UV light may be considered a new standard during the COVID crisis and should be part of every discussion. FDA statement[4]

3. Product Configuration
   a. Surface Disinfection
      i. Our surface application of UV technology is based on quantified benchmarks for effective sterilization. BURNS 2020[5]
      ii. Pulse Zenon technology is inferior to our continuous UV-C lamp output as demonstrated in a trial (2 acute care hospitals) that showed the PX and UV were effective at surface sterilizations. However, "Continuous UV-C achieved significantly greater log10CFU reductions than PX-UV irradiation on glass carriers." ICHE 2015[6]

[1] Enhanced terminal room disinfection and acquisition and infection caused by multidrug-resistant organisms and *Clostridium difficile* (the Benefits of Enhanced Terminal Room Disinfection study): a cluster-randomised, multicentre, crossover study. Anderson et al LANCET 2017; v. 389; p. 805-14.
[2] www.cdc.gov
[3] ACGIH, 1992, Industrial Ventilation, 21st ed., p. 2-2. Cincinnati, Ohio; Am. Conf. Govern. Industrial Hygienists. (Anecdote)
[4] Enforcement Policy for Sterilizers, Disinfectant Devices, and Air Purifiers During the Coronavirus Disease 2019 (COVID-19) Public Health Emergency Guidance for Industry and Food and Drug Administration Staff March 2020, U.S. Department of Health and Human Services, Food and Drug Administration
[5] Ultraviolet-C decontamination of a hospital room: Amount of UV light needed. Lindblad et al. BURNS 46(2020) 842-849
[6] Infect Control Hosp Epidemiol. 2015 Feb;36(2):192-7

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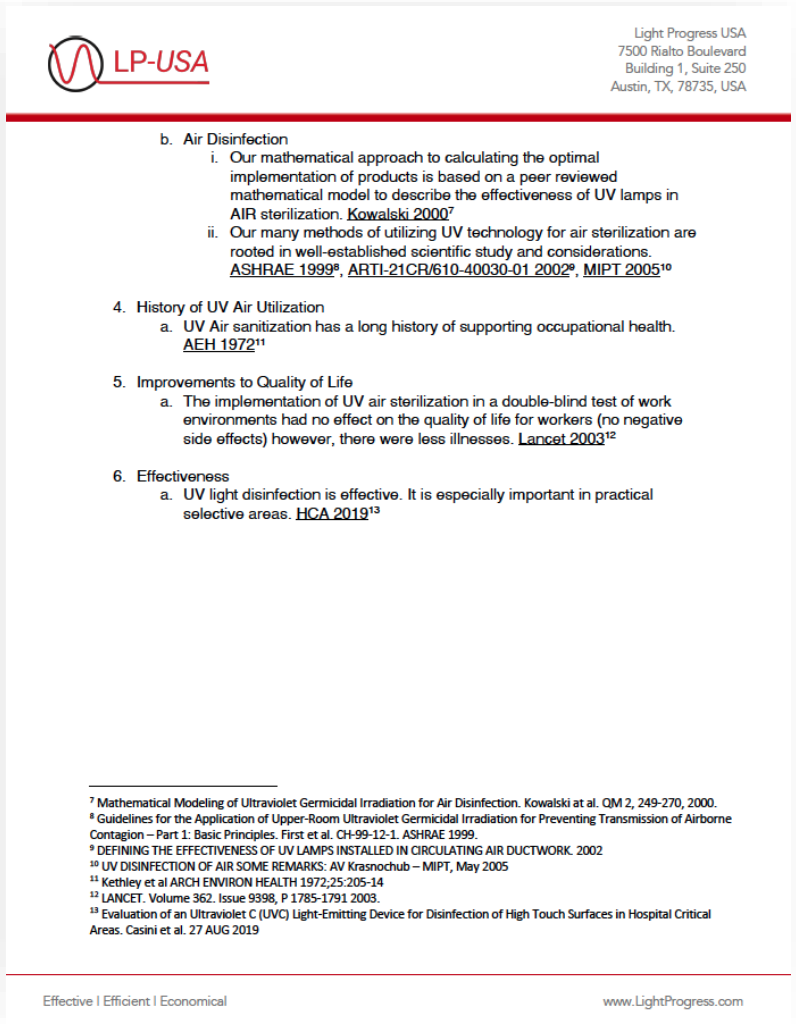

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   b. Air Disinfection
      i. Our mathematical approach to calculating the optimal implementation of products is based on a peer reviewed mathematical model to describe the effectiveness of UV lamps in AIR sterilization. Kowalski 2000[7]
      ii. Our many methods of utilizing UV technology for air sterilization are rooted in well-established scientific study and considerations. ASHRAE 1999[8], ARTI-21CR/610-40030-01 2002[9], MIPT 2005[10]

4. History of UV Air Utilization
   a. UV Air sanitization has a long history of supporting occupational health. AEH 1972[11]

5. Improvements to Quality of Life
   a. The implementation of UV air sterilization in a double-blind test of work environments had no effect on the quality of life for workers (no negative side effects) however, there were less illnesses. Lancet 2003[12]

6. Effectiveness
   a. UV light disinfection is effective. It is especially important in practical selective areas. HCA 2019[13]

[7] Mathematical Modeling of Ultraviolet Germicidal Irradiation for Air Disinfection. Kowalski at al. QM 2, 249-270, 2000.
[8] Guidelines for the Application of Upper-Room Ultraviolet Germicidal Irradiation for Preventing Transmission of Airborne Contagion – Part 1: Basic Principles. First et al. CH-99-12-1. ASHRAE 1999.
[9] DEFINING THE EFFECTIVENESS OF UV LAMPS INSTALLED IN CIRCULATING AIR DUCTWORK. 2002
[10] UV DISINFECTION OF AIR SOME REMARKS: AV Krasnochub – MIPT, May 2005
[11] Kethley et al ARCH ENVIRON HEALTH 1972;25:205-14
[12] LANCET. Volume 362. Issue 9398, P 1785-1791 2003.
[13] Evaluation of an Ultraviolet C (UVC) Light-Emitting Device for Disinfection of High Touch Surfaces in Hospital Critical Areas. Casini et al. 27 AUG 2019

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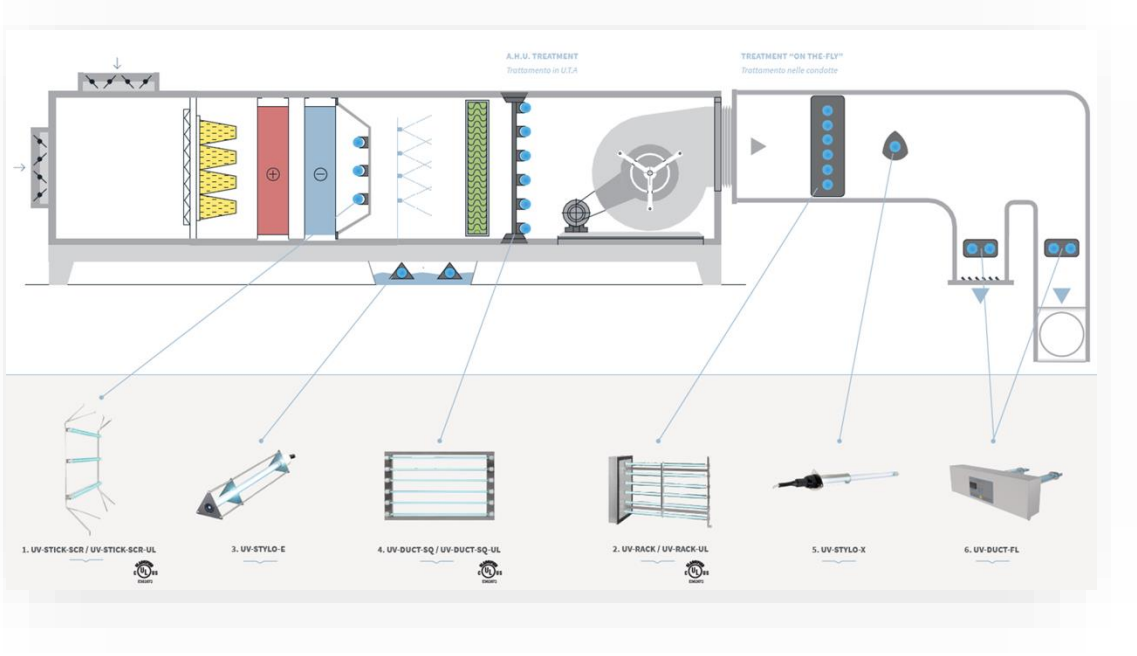
Chief Science Officer

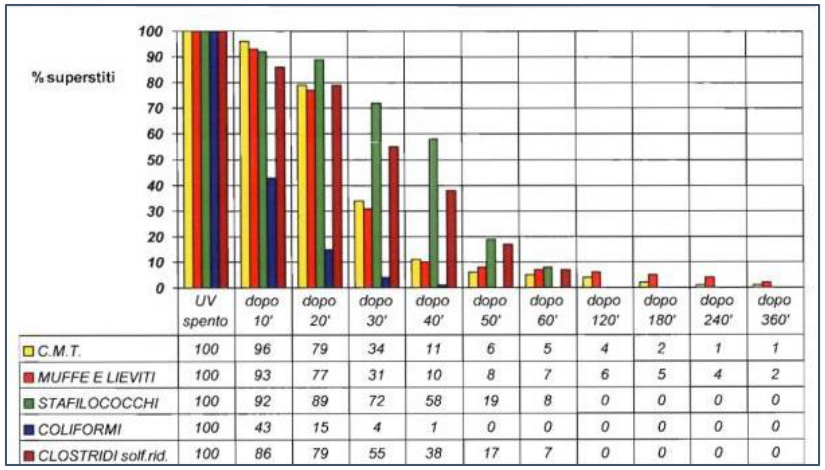
- Carl R. Peterson III, MD MS DABR
- Practicing Radiation Oncologist
- Medical Director
- Oncology Service Line

UV Disinfection: Air Treatment

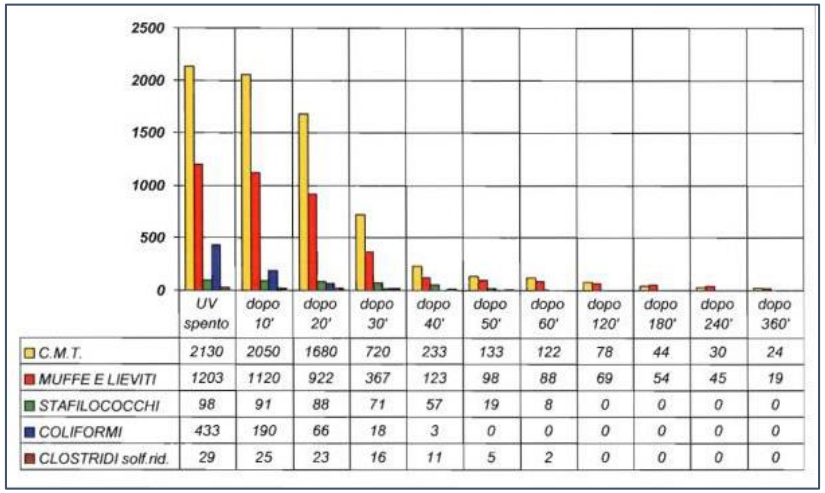
Our products are designed to fit precisely into various sections of the Air Handling Units, as well as inside the ducts. All our HVAC products are dimensioned to the air conditioning system in order to guarantee safe results.



As you can see from the graphs, which can be found on "Study on UV-FAN M1 25 efficacy by Siena Univ", the percentages of microbial reduction of Light Progress systems are between 99.99% for bacteria and 99% for viruses, at every air passage.



	UV spento	dopo 10'	dopo 20'	dopo 30'	dopo 40'	dopo 50'	dopo 60'	dopo 120'	dopo 180'	dopo 240'	dopo 360'
C.M.T.	100	96	79	34	11	6	5	4	2	1	1
MUFFE E LIEVITI	100	93	77	31	10	8	7	6	5	4	2
STAFILOCOCCHI	100	92	89	72	58	19	8	0	0	0	0
COLIFORMI	100	43	15	4	1	0	0	0	0	0	0
CLOSTRIDI solf.rid.	100	86	79	55	38	17	7	0	0	0	0



	UV spento	dopo 10'	dopo 20'	dopo 30'	dopo 40'	dopo 50'	dopo 60'	dopo 120'	dopo 180'	dopo 240'	dopo 360'
C.M.T.	2130	2050	1680	720	233	133	122	78	44	30	24
MUFFE E LIEVITI	1203	1120	922	367	123	98	88	69	54	45	19
STAFILOCOCCHI	98	91	88	71	57	19	8	0	0	0	0
COLIFORMI	433	190	66	18	3	0	0	0	0	0	0
CLOSTRIDI solf.rid.	29	25	23	16	11	5	2	0	0	0	0

Internal Software: Integration Calculations

Thanks to our long experience in the field, the available scientific studies and based on the valuable indications of the major manufacturers of air conditioning systems, we calculate the exact amount of UV power needed to obtain the required results in each individual HVAC system by customizing each application.

The proprietary LIGHT PROGRESS software produces a reliable and consistent approach for developing effective customized UV-C solutions.

Calculation of the UVC power required in air conditioning systems (fill in all the green boxes)

The calculation brings back the number of Light Progress' lamps necessary to reach the needed results. After, You can choose the Light Progress' device that fits to the dimensions of the DUCT/AHU, referring to the compatible devices listed alongside the lamp results.

Airflow	Cubic Feet / Minute	1,000
Shortest Measurement (length or width) of the DUCT or AHU (D) in mm	Inches	14
Longest Measurement (length or width) of the DUCT or AHU in mm	Inches	26
DUCT or AHU material (Two-Letter Material Code)	Material (e.g. "AA", "AB", etc.)	AA
Microorganism to eliminate (Letter Code)	Micro-organism ("A", "B", etc.)	M
No of Logs of reduction (1 Log = 90%, 2 Log = 99%, 3 Log = 99,9%, 4 Log = 99,99%)	Desired Log (1,2,3,ecc.)	1
Relative Humidity Value (0% to 100%)	Humidity=%	60
Temperature (Degrees)x	Temp=°F	69

Light Progress' Lamp Model	Length B/F B/F (inches)*	Number of lamps	Compatible Products
N° LAMPS GH2-11W	10.0	8.0	UV-STYLO-X
N° LAMPS GH3-16W	12.5	5.2	UV-FCU
N° LAMPS GH5-25W	21.6	2.5	UV-STYLO-X
N° LAMPS GH4-40WH (High Output)	17.8	1.4	UV-RACK
N° LAMPS GH6-60WH (High Output)	23.6	0.9	UV-FCU
N° LAMPS GH9-90WH (High Output)	35.8	0.6	UV-STYLO-X
N° LAMPS GH11-120WH (High Output)	46.9	0.4	
N° LAMPS GH15-75W	61.2	0.7	UV-FCU
N° LAMPS GH15-150WH (High Output)	61.2	0.3	
N° LAMPS CHS 40 WH (High Output)	17.2	1.3	UV-STICK-AL
N° LAMPS CHS 60 WH (High Output)	23.6	0.9	UV-STICK- NX
N° LAMPS CHS 90 WH (High Output)	35.2	0.6	UV-STICK-AX
N° LAMPS CHS 120 WH (High Output)	46.3	0.4	UV-DUCT-SQ
N° LAMPS CHS 75 W	61.2	0.7	UV-STICK-AL
N° LAMPS CHS 150 WH (High Output)	61.2	0.3	UV-STICK- NX
			UV-STICK-AX
N° LAMPS GHP 35WH (High Output)	7.7	1.6	
N° LAMPS GHP 60WH (High Output)	15.4	1.0	UV-DUCT-FL
N° LAMPS GHP 95WH (High Output)	19.9	0.5	

* minumum size inside the DUCT/AHU

Necessary dose for 1 Log (90%) reduction of various microorganisms

Dose necessaria per la eliminazione del 90% dei vari microrganismi - Needed dose to obtain 90% reduction of various microorganisms (1 Log) µW*sec./cmq

	Bacteria	
A	Mycobacterium Tubercolosis (TBC)	2150
B	Escherichia Coli ATCC 11229	2400
C	Legionella Pneumophila ATCC 33152	1600
D	Pseudomonas Aeruginosa ATCC 9027	3250
E	Salmonella Enteridis ATCC 6539	2750
F	Stapylococcus Aureus	1600
G	Streptococco Hemolyticus	2200
H	Vibrio Cholerae	2050
I	MRSA	3250
L	Clostridium Difficile	5000
	Virus (Generic DNA & RNA	
M	Virus Influenza "A" / Flu "A" Virus	2750
N	Hepatitis A HM175	4000
O	Corona Virus (Sars COV1 - MERS COV	750
P	Rotavirus	7500
	Molds	
Q	Aspergillus Amstelodami	33350
R	Aspergillus Brasiliensis (Niger)	113000
	Yeasts	
S	Common Yeasts / Comuni lieviti dolciari	6000
T	Brewer's Yeast	10000

Material - UVC reflectivity

Type	Material	Correction Factor
AA	Galvanised steel sheet/plate	1,1
AB	Inox (Stainless steel) 2B	1,15
AC	Inox (Stainless steel) BA mirrored	1,22
AD	Aluminium SPECULAR BRILL	2,15

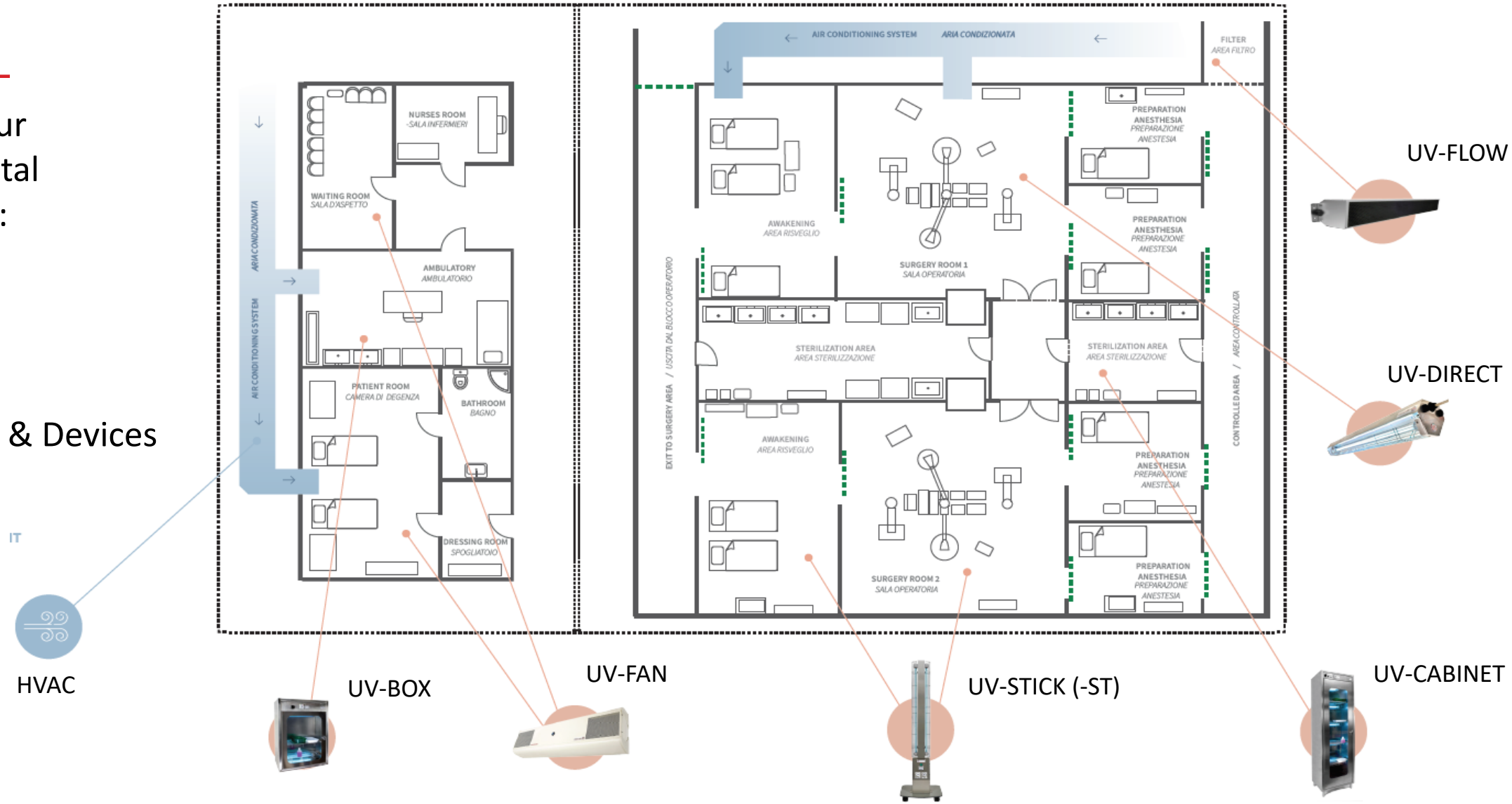
AD is a special aluminium that have high reflectivity about UVC light. It can be used to coat the inner walls of the DUCT /AHU. It can be supplied by Light Progress on request

LIGHT PROGRESS
UltraViolet Germicidal Irradiation

General Application Schematic

Diversify your Environmental Disinfection:

- -HVAC
- -In-Room
- -Surface
- -PPE, Tools & Devices



Solution:
Suggested Products

Persistent In-Room Air Treatment

UV-FAN and UV-FLOW allow for deep air disinfection in any type of environment. The big advantage of these machines is the ability to deal with the air while people are present, 24 hours a day. Only a continuous disinfectant action can ensure the security to maintain the microbial load is always under control. People can see the products and have comfort in the safety of air quality.

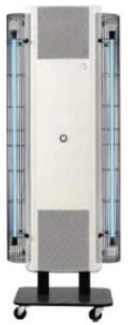
UV Fan: Air Treatment

LIGHT PROGRESS

UV-FAN

Professional High-Performance UV-C Air Purifier w/ TiOX Filter Catalyzer

UV-FAN-M2/95PH



UV-FAN-M2/95PH-BD-ST-Rc

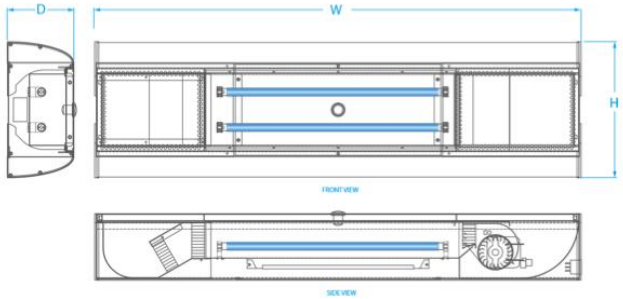
UV-FAN-M2/95PH-ST

UV-FAN-M2/95PH-BD

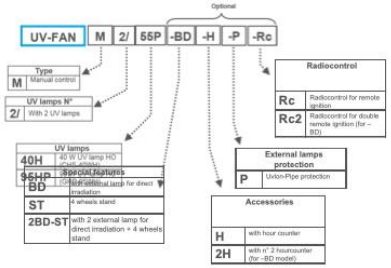
Wall-Mounted or Mobile Versions | 18,000 Hour Ozone-Free Pure Quartz 254NM UV-C Lamps
Safe to Use 24/7 in the Presence of People | Whisper Quiet (44Db) | 450 sq.ft. Coverage Area
Nano-Structured TiOX Filter | Proven 99.9% Reduction in Contaminant Load
2 x 95W Internal Lamps at 120V | IP20 Rating | Suitable for Class 1 Installations

UV FAN MODEL	DIMENSIONS WxHxD (in.)	AIR FLOW (CFM)	Consumption Watts	IRRAD. AREA Sq Ft (9Ft Ht)	IRRAD. VOLUME. (ft 3)	Surface Area Irradiated. (Sq ft)
UV-FAN-M2/95PH	48 x12 x 5	88	220 W	450	3530	N/A
UV-FAN-M2/95PH-ST	48 x 12 x 5	88	220 W	450	3530	N/A
UV-FAN-M2/95PH-BD	41 x 8 x 5	88	220 W + 55 W	450	3530	160
UV-FAN-M2/95PH-BD-ST-Rc	48 x16 x 5	88	220 W + 110 W	550	4415	320

TECHNICAL DRAWINGS -



CODES -



TiOX Filter Catalyzer -

A titanium dioxide (TiO_2) nano-structured photocatalyst (TiOx®) which oxidizes then degrades contaminants when activated by high emission UV-C lamps placed inside the UV-FAN device.

INSTALLATION -

These devices (except for the models with support) should be installed on the wall, at the center of the room, about 6 feet. above ground level (avoid positioning at corners; the air captured and treated by the device must be allowed to circulate through the room unhindered). The final result of the disinfection is however related to a higher or lower value of the outside contribution of germs in the air during UV disinfection. To install the device on the wall use the two triangular brackets enclosed in the packaging. Screw the brackets to the threaded holes on the back side of the device by use of bolts (M6x10) enclosed in the packaging. Make 2 holes on the wall by checking the center distance between the brackets. Secure the device to the wall by means of two expanding wall plugs (Ø 8 - Ø10 mm.) (not provided).

LIGHT PROGRESS
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Experience:
Our Certifications

APPENDIX

Competition:
Competing Technologies

- **Bipolar Ionization**
- Pulse Xenon
- Dry Hydrogen Peroxide (DHP)

Competition: Bipolar Ionization

- Point Bipolar Ionization (BPI)
  - Used with incomplete combustion in Chimneys & Power Plants for 50-60 year. It has been used to remove odors and treat free radicals to make less harmful radicals.
  - Needlepoint Bipolar Ionization began patented in the late 90s. The theory is to charge the air with positive radicals and negative radicals (ions) that are unstable molecules that desire to be neutral. The ions associate themselves with small particles and other compounds to change the molecular makeup of those particles and compounds by forming new compounds.
  - In fact ASHRAE warns that incomplete reactions can produce unintended harmful compounds.
  - The effectiveness and applicability to human safety is not validated by third party science, only manufacturer's claims.
- Ozon Creation : The needle brings high charge into a small surface and electrostatic fields are produced and ionization happens.
  - Once the discharge happens there is no control over what compound the ionization is producing. If oxygen is in the air ozone will be produced. Ozone is a lung irritant and whenever it is produced, warnings are present for the young, old, and people susceptible to respiratory illness.
  - The EPA has identified ozone as a lung irritant. The acceptable ozone recommendation from the EPA is 0.05 ppm for medical devices.

Competition: Bipolar Ionization

ASHRAE Epidemic Task Force
Filtration & Disinfection
Updated 10-20-2020

https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-filtration_disinfection-c19-guidance.pdf

Bipolar Ionization/Corona Discharge/ Needlepoint Ionization and Other Ion or Reactive Oxygen Air Cleaners

- Air cleaners using reactive ions and/or reactive oxygen species (ROS) have become prevalent during the COVID-19 pandemic. New devices that are not mentioned elsewhere in this guidance likely fall into this category.
- High voltage electrodes create reactive ions in air that react with airborne contaminants, including viruses. The design of the systems can be modified to create mixtures of reactive oxygen species (ROS), ozone, hydroxyl radicals and superoxide anions.
- Systems are reported to range from ineffective to very effective in reducing airborne particulates and acute health symptoms.
- Convincing scientifically-rigorous, peer-reviewed studies do not currently exist on this emerging technology; manufacturer data should be carefully considered.
- Systems may emit ozone, some at high levels. Manufacturers are likely to have ozone generation test data.

For more information, see the ASHRAE Position Document on Filtration and Air Cleaning and CDC Response to ASHRAE ETF on Bipolar Ionization.

ASHRAE

Competition: Bipolar Ionization

ASHRAE Epidemic Task Force
Filtration & Disinfection
Updated 10-20-2020

https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-filtration_disinfection-c19-guidance.pdf

CDC Position on Bipolar Ionization

ASHRAE does not currently have a Society position on bipolar ionization. However, the ASHRAE ETF did reach out to CDC for their position on the technology. The following is the response from CDC in its entirely:

Thank you for your question. Although this was pointed out in the earlier CDC responses, it is important for me to re-emphasize that CDC does not provide recommendations for, or against, any manufacturer or manufacturer's product. While bi-polar ionization has been around for decades, the technology has matured and many of the earlier potential safety concerns are reportedly now resolved. If you are considering the acquisition of bi-polar ionization equipment, you will want to be sure that the equipment meets UL 2998 standard certification (Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners) which is intended to validate that no harmful levels of ozone are produced. Relative to many other air cleaning or disinfection technologies, needlepoint bi-polar ionization has a less-documented track record in regards to cleaning/disinfecting large and fast volumes of moving air within heating, ventilation, and air conditioning (HVAC) systems. This is not to imply that the technology doesn't work as advertised, only that in the absence of an established body of evidence reflecting proven efficacy under as-used conditions, the technology is still considered by many to be an "emerging technology". As with all emerging technologies, consumers are encouraged to exercise caution and to do their homework. Consumers should research the technology, attempting to match any specific claims against the consumer's intended use. Consumers should request efficacy performance data that quantitively demonstrates a clear protective benefit under conditions consistent with those for which the consumer is intending to apply the technology. Preferably, the documented performance data under as-used conditions should be available from multiple sources, some of which should be independent, third party sources.

ASHRAE

Competition: Bipolar Ionization

"Convincing scientifically-rigorous, peer-reviewed studies do not currently exist on this emerging technology; manufacturer data should be carefully considered." - ASHRAE

"…needlepoint bi-polar ionization has a less-documented track record in regards to cleaning/disinfecting large and fast volumes of moving air within heating, ventilation, and air conditioning (HVAC) systems." – CDC Response

https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-filtration_disinfection-c19-guidance.pdf

Competition:
Competing Technologies

- Bipolar Ionization
- **Pulse Xenon**
- Dry Hydrogen Peroxide (DHP)

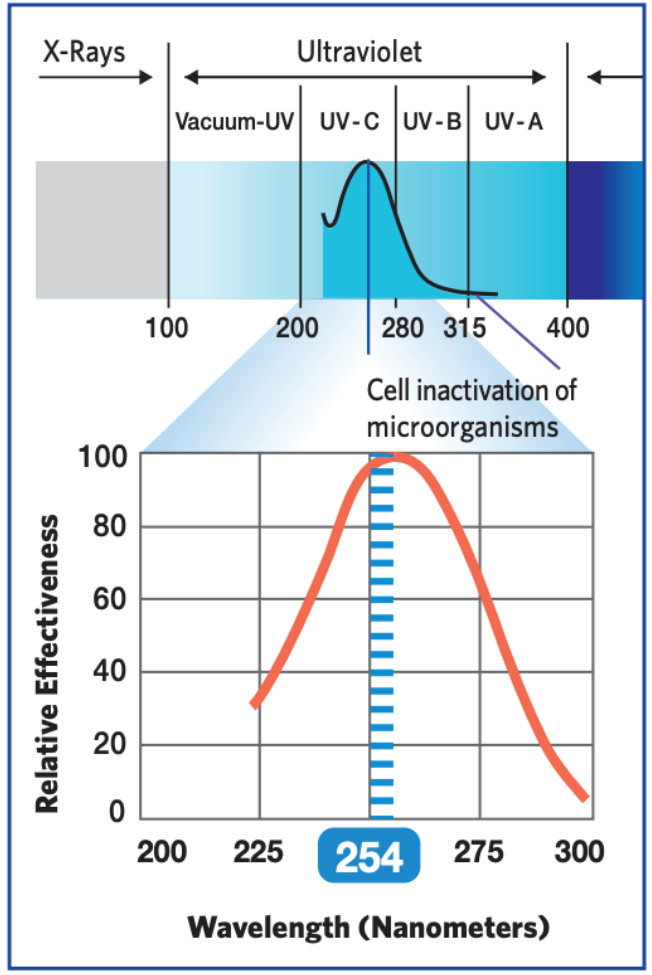
Competition: Pulsed Xenon

History:

- Patented in Japan in 1980 and extended to US in 1984.
  - *"A method of sterilization effected by using flash discharge ultraviolet lamp which provides a very large instantaneous luminescence output, destroying at an increase sterilization rate and in a reduced irradiation time micro-organisms, particularly Aspergillus niger and those organisms in the lower layers which have been difficult to destroy by the lamp method of the prior art."*
- Studied in the mid 80's to gather data on various biological agents
- In 1996 proposed and adopted by the US Food and Drug administration for food processing
- Commercialized since 2000

Competition: Pulsed Xenon

Studies demonstrate that the effective UV wavelength for killing microorganisms is near 260nm. At this wavelength, pyrimidine dimerization, the primary mechanism for microorganism inactivation by UV-C light, occurs. The EPA reports that, “Pyrimidine dimers are the most common form of nucleic acid damage, being 1000 times more likely to occur than [other mechanisms of action].” Thus, pulsed-xenon UV devices that emit broad-spectrum UV actually generate non-useful UV energy, which is a detriment to pathogen reduction. Additionally, other possible mechanisms of cellular damage, as described by pulsed-xenon manufacturers, are only marginally relevant for pathogen reduction. Furthermore, studies have shown that low-pressure mercury UV lamps operate at a significantly higher efficiency than pulsed-xenon UV lamps.



Schaefer, Raymond et al. Pulsed UV lamp performance and comparison with UV mercury lamps. J. Environ. Eng. Sci. Vol. 6, 2007: 303-310

Competition: Pulsed Xenon

ASHRAE Epidemic Task Force
Filtration & Disinfection
Updated 10-20-2020

https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-filtration_disinfection-c19-guidance.pdf

Pulsed Xenon (Pulsed UV)

- High-powered UV lamps (generally containing xenon gas) used in rapid pulses of intense energy.
- Emits a broad brand of visible and ultraviolet wavelengths, with a significant fraction in the UV-C band.
  - Uses significantly higher power outputs that usual UV-C techniques
  - Inactivates viruses, bacteria and fungi using the same mechanisms as standard UV-C systems
- Typically used for healthcare surface disinfection but can be used in HVAC systems for air and surface disinfection.

For more information, see the FAQs on Germicidal Ultraviolet (GUV) published by the Illuminating Engineering Society (IES) Photobiology Committee.

Competition: Pulsed Xenon

A 2015 Study: **Evaluation of a Pulsed Xenon Ultraviolet Disinfection System for Reduction of Healthcare-Associated Pathogens in Hospital Rooms**

"Continuous UV-C achieved significantly greater log10CFU reductions than PX-UV irradiation on glass carriers."

Citation: Michelle M. Nerandzic, Priyaleela Thota, Thriveen Sankar C., Annette Jencson, Jennifer L. Cadnum, Amy J. Ray, Robert A. Salata, Richard R. Watkins and Curtis J. Donskey (2015). Evaluation of a Pulsed Xenon Ultraviolet Disinfection System for Reduction of Healthcare-Associated Pathogens in Hospital Rooms. Infection Control & Hospital Epidemiology, 36, pp 192-197 doi:10.1017/ice.2014.36

Competition: Pulsed Xenon

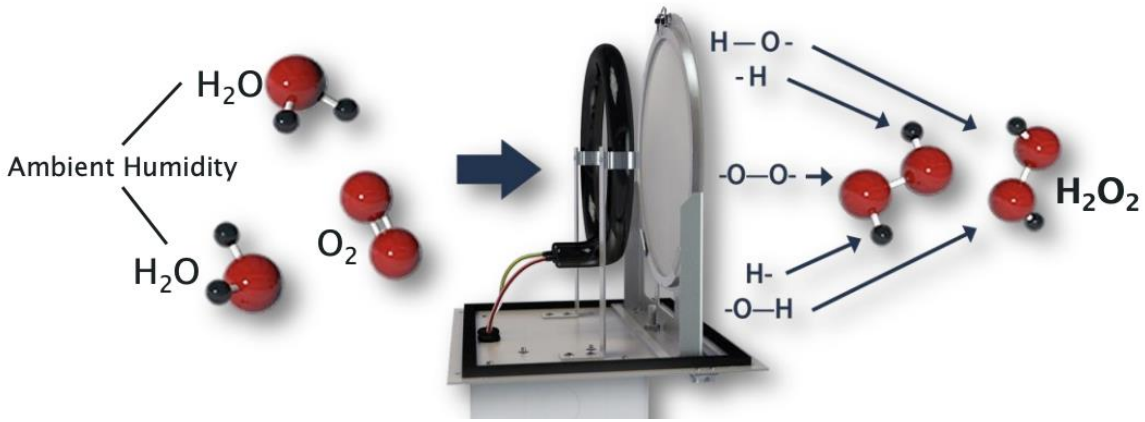
Competitive Advantages:

- Using Pulsed Xenon is “like hunting for ducks with a bazooka”
- It is not validated by third party science for air disinfection
- The lamps can not be replaced, the entire fixture must be disgarded
- More on Pulsed Xenon safety and applicability IES Committee Report: Germicidal Ultraviolet (GUV) – Frequently Asked Questions (referenced by ASHRAE): https://media.ies.org/docs/standards/IES-CR-2-20-V1-6d.pdf

Competition:
Competing Technologies

- Bipolar Ionization
- Pulse Xenon
- **Dry Hydrogen Peroxide (DHP)**

Competition: Hydrogen Peroxide



Vaporized Hydrogen Peroxide

- Can not be used in the presence of people.
- Air must be scrubbed before people can be present.

Dry Hydrogen Peroxide (DHP)

- Hydrogen peroxide gas is not vapor.
- Is used in the presence of people.
- Claims to be effective at 1/25th the OSHA recommended limit for human exposure.
- Microbes attach to H2O2 because it is similar to the structure of water. Without the water the microbes die sooner.
- Typically results are tested over hours, days, and weeks.
- Not a great deal of third-party evidence developed yet.