

Lumenal Lighting Presents UV ABCs

AN INTRODUCTION TO ULTRAVIOLET (UV) ENERGY AND HOW LIGHT CAN BE
IMPLEMENTED AS A TOOL TO BOLSTER DISINFECTION EFFORTS





Anywhere you find people is an opportunity for disinfection, germicides, and antimicrobial light. Let us take a look at some common situations where microorganisms and pathogens exist, and potential radiant energy solutions to combat their negative impact.

- ▶ Visible Light
- ▶ UVC – Mobile & Handheld
- ▶ GUV for unoccupied spaces
- ▶ Far-UVC
- ▶ Upper Room Ultraviolet

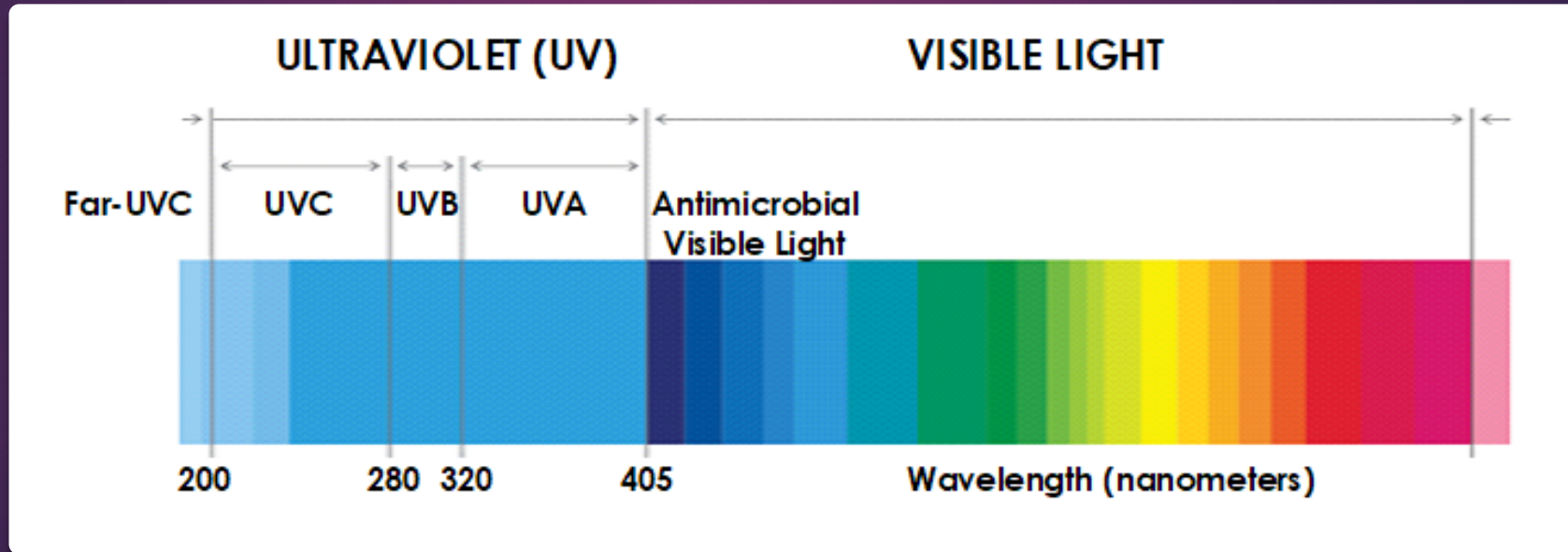
What is the Electromagnetic Spectrum and Ultraviolet (UV) Energy?

- ▶ Ultraviolet (UV) Energy is the section of the electromagnetic spectrum measuring 400 to 40 nanometers (nm). Visible light ranges from 740 to 380 nm.
- ▶ Remember good old ROY G. BIV from school science classes? Ultraviolet comes right after that.
- ▶ Both visible light and UV are used in disinfection.
- ▶ The most effective electromagnetic ranges for disinfection are far-UVC, UVC, and one very specific wavelength of visible light.



Why are nanometers important?

- ▶ The wavelength (nm) of each type of electromagnetic radiation determines its effectiveness against different types of photosensitive pathogens
- ▶ The wavelength also determines the potential for harm to humans if exposed
- ▶ When choosing a light or UV source for cleaning, one must find the appropriate wavelength for the purpose



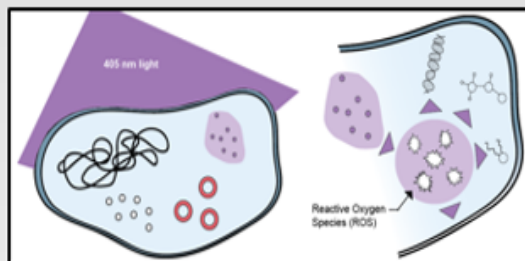


Crowded commercial spaces yield great opportunities for antimicrobial, visible light

- Harmful microorganisms are suspended in air, trapped on objects, and linger on “high touch surfaces such as door handles, stair railings, and counters.
- People spread infection, contamination, and a myriad of airborne illnesses.
- Restaurants, cafeterias, and food courts combine crowds of people with foodborne illness risk.
- Strategically combining white and narrowband 405 nanometer visible light would work well.

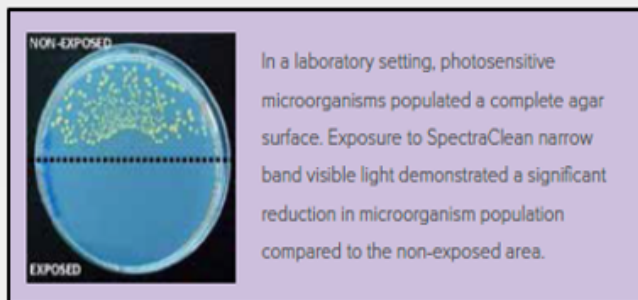
Hubbell's SpectraClean™ uses antimicrobial visible light

Photosensitive pathogens absorb High Intensity Narrow Spectrum (HINS) light.



HINS light accelerates the creation of damaging reactive oxygen species (ROS).

Cell damage leads to cell inactivation.



In a laboratory setting, photosensitive microorganisms populated a complete agar surface. Exposure to SpectraClean narrow band visible light demonstrated a significant reduction in microorganism population compared to the non-exposed area.



Is proven effective For:

Foodborne Risks

Food poisoning - *Campylobacter jejuni*
E coli - *Escherichia coli*
Salmonella - *Salmonella enteritidis*
Listeria - *Listeria monocytogenes*
C Diff - *Clostridium difficile*
Shigella - *Shigella sonnei*
Bacillus cereus
C. perfringens - *Clostridium perfringens*

Airborne Risks

Pneumoniae - *Klebsiella pneumoniae*
Corynebacterium striatum
Acinetobacter baumannii
Serratia spp
Pseudomonas aeruginosa
FCV - Feline calicivirus

Surface Contamination Risks

MRSA - *Staphylococcus aureus*
Staph - *Staphylococcus epidermidis*
Staph - *Staphylococcus hyicus*
Strep Throat - *Streptococcus pyogenes*
Thrush - *Candida albicans*
Skin Infections - *Mycobacterium terrae*
Proteus vulgaris
Serratia spp

Infection Risks

E. faecium - *Enterococcus faecium*
MRSA - *Staphylococcus aureus*
Pneumoniae - *Klebsiella pneumoniae*
Acinetobacter baumannii
Pseudomonas aeruginosa
(Antibiotic resistant ESKAPE Pathogens)

Research provided by the



Hubbell's
SpectraClean™
is available in a
variety of
popular form
factors to
seamlessly
retrofit into
existing spaces



SCCT

SpectraClean™ Contemporary
Architectural Troffer

Office | Education | Transportation | Retail | Food Service Projects



SCLT

SpectraClean™ Lensed Troffer

Office | Education | Transportation | Retail | Food Service Projects



SCST

SpectraClean™ Striplight

Storage | Utility | Food Preparation



SCVM

SpectraClean™ Linear Vaportite

Storage | Utility | Food Manufacturing | Food Processing | Food Preparation



SCVW

SpectraClean™ Linear Vaportite

Storage | Utility | Food Manufacturing | Food Processing | Food Preparation

Visible light is effective in some cases but UVC & far-UVC are best against germs, bacteria, and viruses

- UVC has great potential for use in schools, medical facilities, retail spaces, gyms, and offices.
- Care must be taken to avoid direct UVC human exposure.
- Far-UVC combines the effectiveness of UVC but in wavelengths considered safe for humans.



The Public Health and Safety Organization

Total Aerobic Bacteria per Square Inch



Sample Location	(Colony Forming Units / in sq)
Water Fountain Spigot (classroom)	2,700,000 CFU/in sq
Water Fountain Spigot (cafeteria)	62,000 CFU/in sq
Plastic Reusable Cafeteria Tray	33,800 CFU/in sq
Faucet (cold water handle)	32,000 CFU/in sq
Faucet (hot water handle)	18,000 CFU/in sq
Cafeteria Plate	15,800 CFU/in sq
Keyboard (classroom)	3,300 CFU/in sq
Toilet Seat	3,200 CFU/in sq
Student's Hand	1,200 CFU/in sq
Animal Cage	1,200 CFU/in sq

What are the ABCs in UV Energy?

UVA

400-320 NM

Longest Wavelength

Most prevalent form of UV; makes up 95% of UV radiation reaching earth's surface.

Responsible for tanning, skin aging, and may contribute to skin cancer. However, it assists vitamin D production and small amounts are considered important to overall human health.

UVB

320-280 nm

Medium Wavelength

Primary contributing cause of sunburns, premature skin aging, and skin cancer development.

Helps in vitamin D production for human health, but exposure should be limited and monitored.

UVC

280-200 nm

Shortest Wavelength

Most damaging form of UV but is fortunately filtered naturally by the earth's atmosphere.

Exists in a variety of human-made sources and form factors.

Effective tool in germicidal applications to kill or inactivate microorganisms.

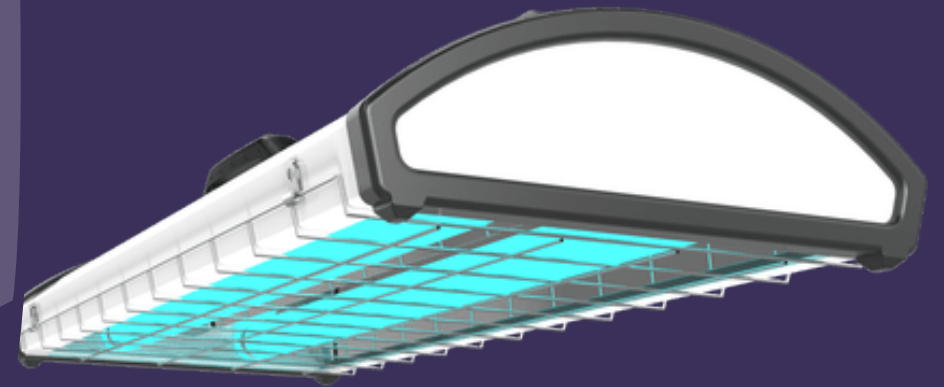
XtraLight® LED Lighting Solutions offers handheld & mobile UVC systems

- ▶ Mobile and handheld UVC solutions may prove best solution for facilities and property management companies.
- ▶ Viable option for airplanes, buses, and other mass transit applications
- ▶ Schedules must be detailed and strictly followed
- ▶ UVC technicians require safety training
- ▶ Potential maintenance service opportunity to ensure proper implementation



XtraLight® offers handheld UVC disinfection

- ▶ Portable handheld device to disinfect and rid spaces of microorganisms
- ▶ Can be used to regularly disinfect workspaces, gear, tools, and equipment
- ▶ 20 ft 5-15p power cord (standard on 120V)
- ▶ Includes mobile carrying case, operator safety gear, warning sign, and dosimeter cards
- ▶ Lightweight and easy to use



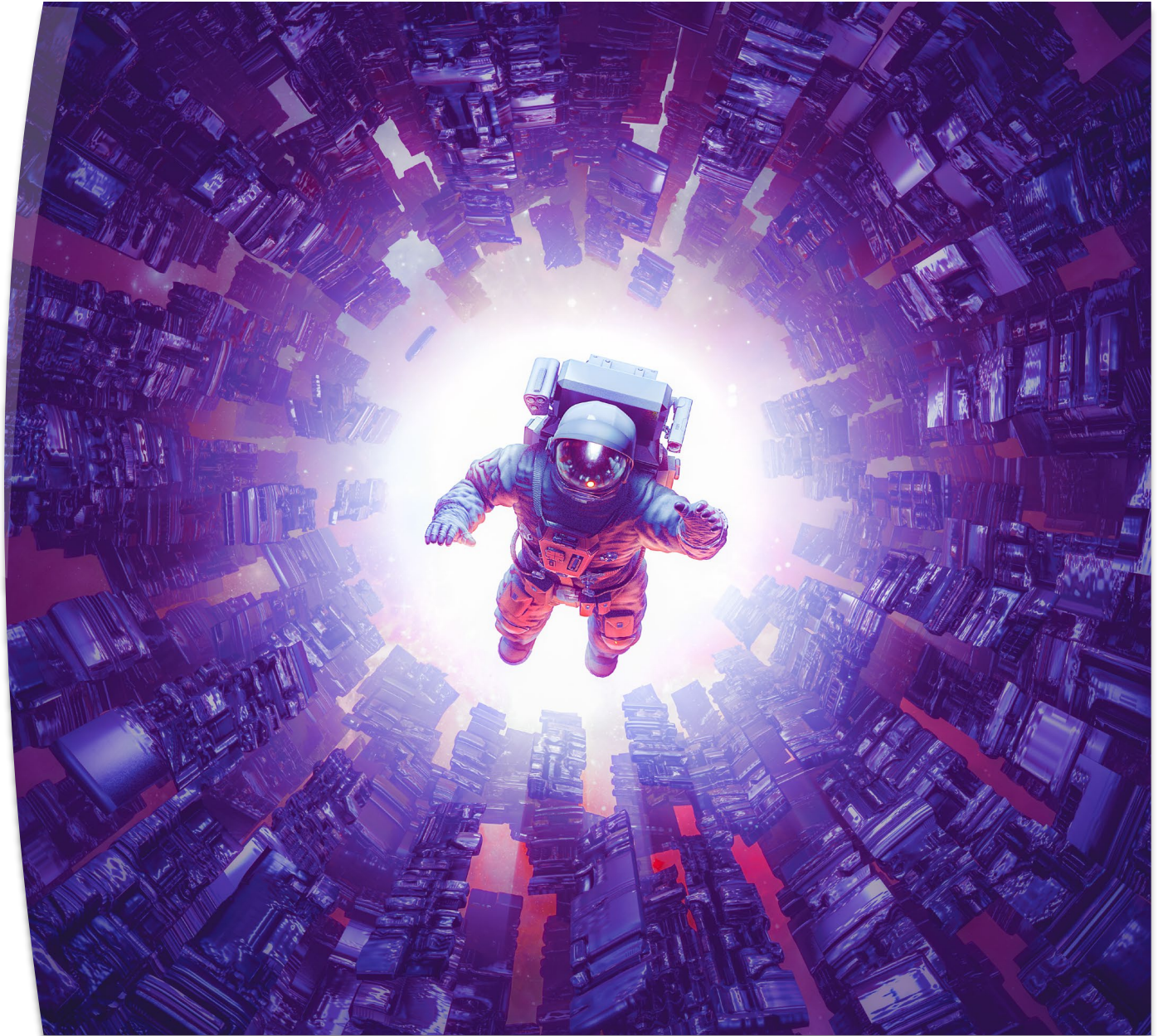
Cooper Lighting Solutions Offers Multiple Germicidal UV Disinfecting Fixtures



- ▶ Fixtures feature germicidal UV lamp technology using quartz enclosure and long-life igniter to maximize the run time and ensure optimal germicidal efficiency
- ▶ Proven technology to combat mold, fungi, bacteria, and viruses
- ▶ Available in high bay, troffer, and linear form factors
- ▶ As with all UVC products, may only operate when spaces are unoccupied due to skin and eye injury

What is Far Ultraviolet (FUV)?

- ▶ There is a narrow range of UV wavelengths that is safe for humans, but dire for viruses and photosensitive pathogens.
- ▶ At 200-122 nm, far-UVC may be the sweet spot of UV for germicidal and disinfection use.
- ▶ Recent studies suggest that far-UVC in may prove effective against airborne viruses, including SARS-CoV-2.
- ▶ Far-UVC technology may be the key to combatting future pandemics due to its ability to be deployed in occupied spaces.



Healthe® by Lighting Science offers far-UVC in Cleanse® Surface Sanitizing Downlight

- ▶ Surface Sanitizing Downlight uses far-UVC to penetrate and inactivate bacteria and viruses without harm to humans
- ▶ Can be easily retrofitted into 6" recessed can fixture housing
- ▶ Spotlight cleaning solution for drinking fountains and other high-touch areas
- ▶ Integrated occupancy sensors with multiple programming options
- ▶ 20W power consumption
- ▶ UVC Lamp lifetime of >3,000 hours



Lighting Science Cleanse® Portal is a futuristic passage to UV sanitization

- ▶ Entry Way portal emits far-UVC to inactivate >90% of bacteria and viruses
- ▶ 222 nm wavelength is considered safe for human exposure
- ▶ UV Sanitizing Entry gates have been incorporated into Seattle Space Needle's reopening plan
- ▶ Effective UV dosage delivered in as little as 20 seconds
- ▶ Viable entrance option for locker rooms, conference rooms, offices, and waiting rooms
- ▶ Complies with ADA and can be deployed as a free-standing structure near any entrance or door





Upper-room UVC may be the best answer for Healthcare applications

Hospitals have been using UVC for decades to combat drug-resistant superbugs, viruses, and bacteria. It is very effective at killing germs and inactivating viruses, but it also causes damage to skin and eye damage when inadvertently exposed.

Exploring Upper-Room Ultraviolet Germicidal Irradiation (UVGI)

Proven Benefits

- ▶ UVGI has been used successfully against a wide range of aerosolized microorganisms, including tuberculosis
- ▶ Upper-room UVC augmented by slow moving air circulation ensures constant germicidal treatment
- ▶ Recent studies suggest that 254 nm is effective against SARS-CoV-2

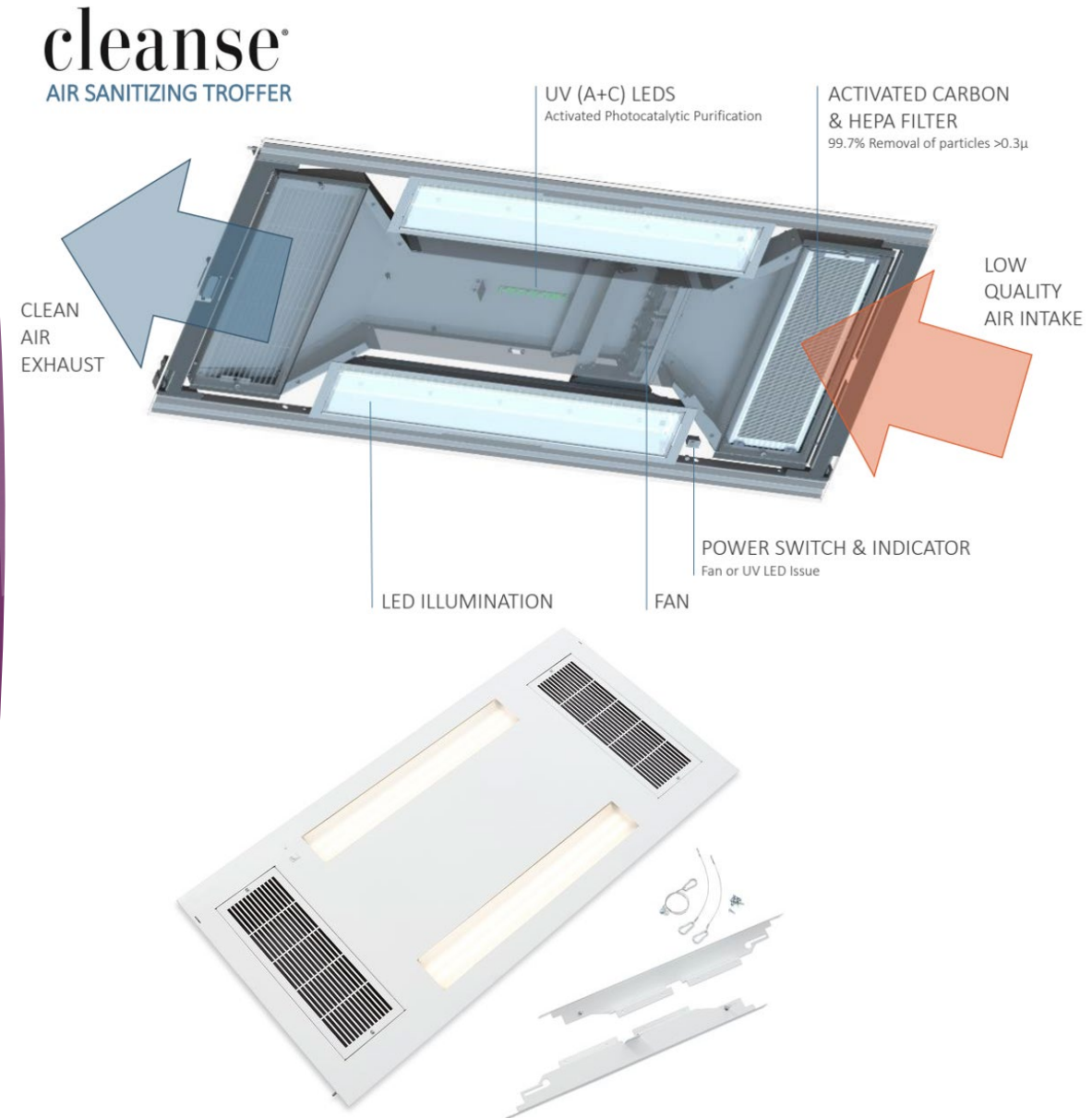


Potential Risks

- ▶ Prolonged exposure to UVC causes cancer
- ▶ Accidental direct exposure results in eye damage
- ▶ Bare-bulb exposure causes skin damage and peeling
- ▶ Extensive design required to mitigate risk of reflective effects

Healthe® by Lighting Science uses UV (A+C) and HEPA filtration in Air Sanitizing Troffer

- ▶ Troffer option combines activated carbon and HEPA filtration with UV (A+C)
- ▶ HEPA filter and UVC should be maintained biannually
- ▶ Troffer is effective against mold, bacteria, and viruses in an 800 ft³ space
- ▶ Replaces typical 2x4 troffer as a light source
- ▶ Available in Healthe's GoodDay 4000K/5000K, GoodNight 2700K, or Standard 3000K color choices





Quick Recap of Visible Light and UV for disinfection

- ▶ There is no one easy solution to cover all applications
- ▶ Personal handheld “UV” wands that advertise a quick solution are misleading and ineffective
- ▶ Visible light and UV do not replace manual sanitizing procedures
- ▶ UVC, far-UVC, and visible light technology is available in a wide variety of form factors for retrofit applications
- ▶ UVC and far-UVC options can be effective against viruses
- ▶ Recent studies suggest that 254nm and 222nm far-UVC could successfully combat Covid-19
- ▶ Lumenal Lighting is tracking new information daily about the success of UV against Covid-19 and future pandemics

Questions?

Hubbell SpectraClean™ Antimicrobial Lighting <https://uat.hubbell.com/hubbellightingci/en/spectraclean>

Healthe® by Lighting Science Cleanse® <https://healthelighting.com/pages/cleanse>

XtraLight® UVC High Power Ultraviolet Disinfection System <https://info.xtralight.com/en-us/uv-ultraviolet-disinfection-system>

Cooper Lighting Solutions Fail-Safe GUV Disinfecting Solutions
<http://www.cooperindustries.com/content/public/en/lighting/resources/LightingStories/guv/products.html>

Philips UV Germicidal Lamps in Lumalier Fixtures <https://www.lumalier.com/products.html>

Signify and Boston University validate effectiveness of Signify's UV-C <https://www.signify.com/global/our-company/news/press-releases/2020/20200616-signify-boston-university-validate-effectiveness-signify-uv-light-sources-on-inactivating-virus-that-causes-covid19>

Space Needle spends \$1M on UV gates and other tech in ambitious reopening plan
<https://www.geekwire.com/2020/inside-seattles-space-needle-1m-spent-cleaning-tech-ensure-safe-reopening/>

Illuminating Engineering Society - IES CR-2-20-V1, Germicidal Ultraviolet (GUV)
<https://www.ies.org/standards/committee-reports/>

Please visit www.lumenal.com for more information on UV & lighting for disinfection and other services available from Lumenal Lighting