

©signify

UV-C  
Disinfection



FROMM

# Our world has fundamentally changed.....or has it?

Event	Date	Death Toll	Location	Disease
1915 Encephalitis lethargica pandemic	1915–1926	1,500,000	Worldwide	Encephalitis lethargica
1918 flu pandemic	1918–1920	17,000,000	Worldwide (up to 100million)	Spanish flu virus (H1N1)
1918–1922 Russia typhus epidemic	1918–1922	2,500,000	Russia	Typhus
1947 Egypt cholera epidemic	1947	10,277	Egypt	Cholera
Poliomyelitis Epidemic	1948	8,005	United States	Poliomyelitis
1957–1958 influenza pandemic	1957–1958	1,000,000	Worldwide (1-4 million actual deaths)	Influenza A virus subtype H2N2
1960–1962 Ethiopia yellow fever epidemic	1960–1962	30,000	Ethiopia	Yellow fever
Seventh cholera pandemic	1961–1975	155,000	Worldwide	Cholera (El Tor strain)
Smallpox Worldwide	1877–1977	500,000,000	Worldwide	Smallpox
Hong Kong flu	1968–1970	1,000,000	Worldwide (1-4 million actual deaths)	Influenza A virus subtype H3N2
1974 smallpox epidemic of India	1974	15,000	India	Smallpox
HIV/AIDS pandemic	1981–present	43,800,000	Worldwide	HIV/AIDS
1984 Western Sahara plague	1984	64	Western Sahara	Bubonic plague
1986 Oju yellow fever epidemic	1986	5,600	Oju, Nigeria	Yellow fever
1987 Mali yellow fever epidemic	1987	145	Mali	Yellow fever
1991 Bangladesh cholera epidemic	1991	10,415	Bangladesh	Cholera
1996 West Africa meningitis epidemic	1996	10,000	West Africa	Meningitis
<b>Queensland 2009 dengue outbreak</b>	2009	503	Queensland, Australia	Dengue fever
2009 swine flu pandemic	2009–2010	575,400	Worldwide	Influenza A virus subtype H1N1
2010s Haiti cholera outbreak	2010–2019	10,075	Haiti	Cholera (strain serogroup O1, serotype Ogawa)
Western African Ebola virus epidemic	2013–2016	11,323	Worldwide (centred in Africa)	Ebola virus disease
2017–18 United States flu season	2017–2018	95,000	United States	Seasonal influenza
<b>2019–2020 New Zealand measles</b>	2019–present	2	New Zealand	Measles
<b>2019 Samoa measles outbreak</b>	2019–present	83	Samoa	Measles
COVID-19 pandemic	2019–present	4,279,366	Worldwide (as of 18 May 2020)	COVID-19 / SARS-CoV-2

\*Notable disease events above 10K deaths since 1915 + recent local events

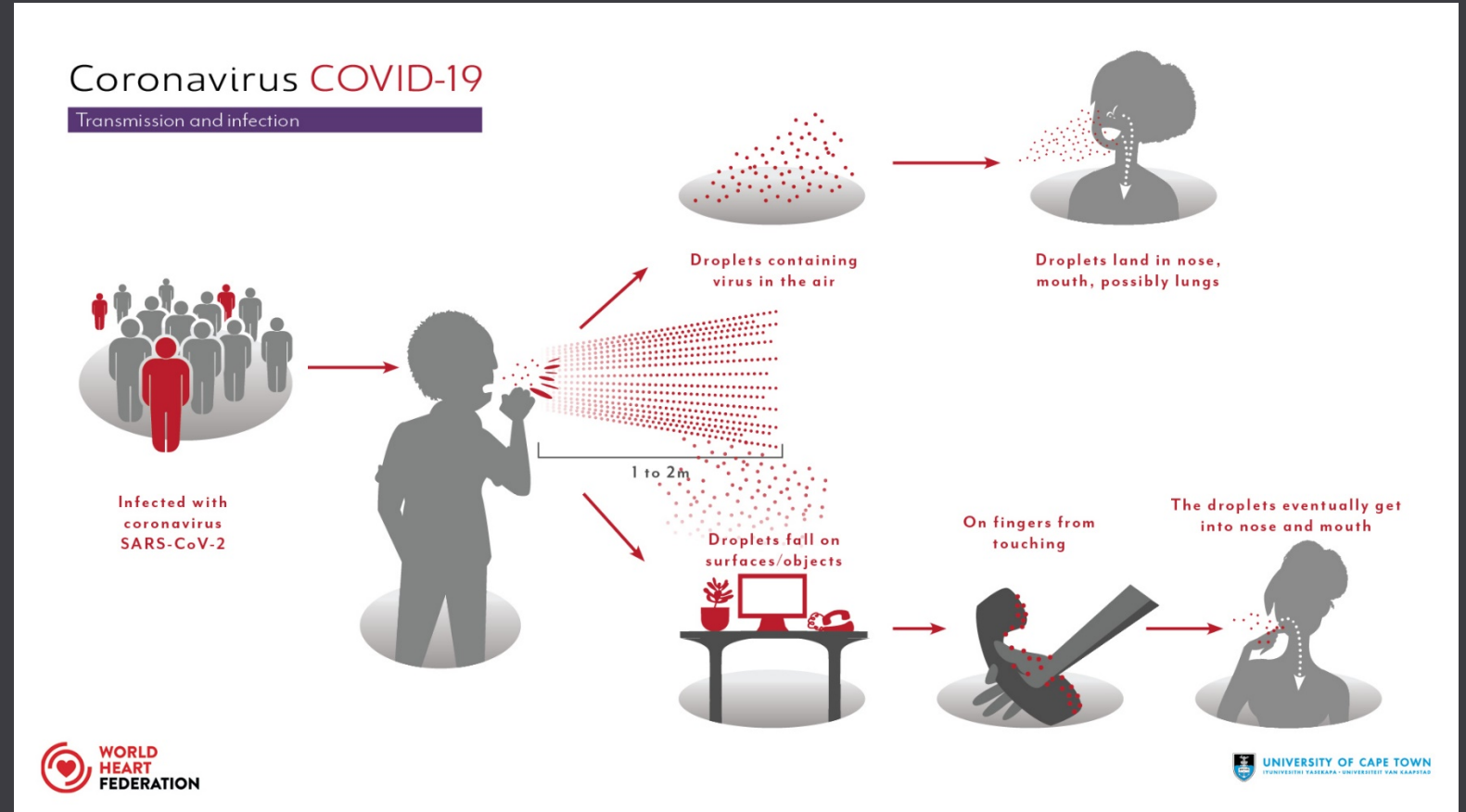
Signify

Why does  
air & surface  
disinfection matter?

# Channels of transmission

The virus spreads mainly from person-to-person transmission in 3 basic modes:

- Direct air-borne transmission **between people**
- Indirect surface-borne transmission via **contaminated surfaces**
- Indirect air-borne transmission through **air flows**



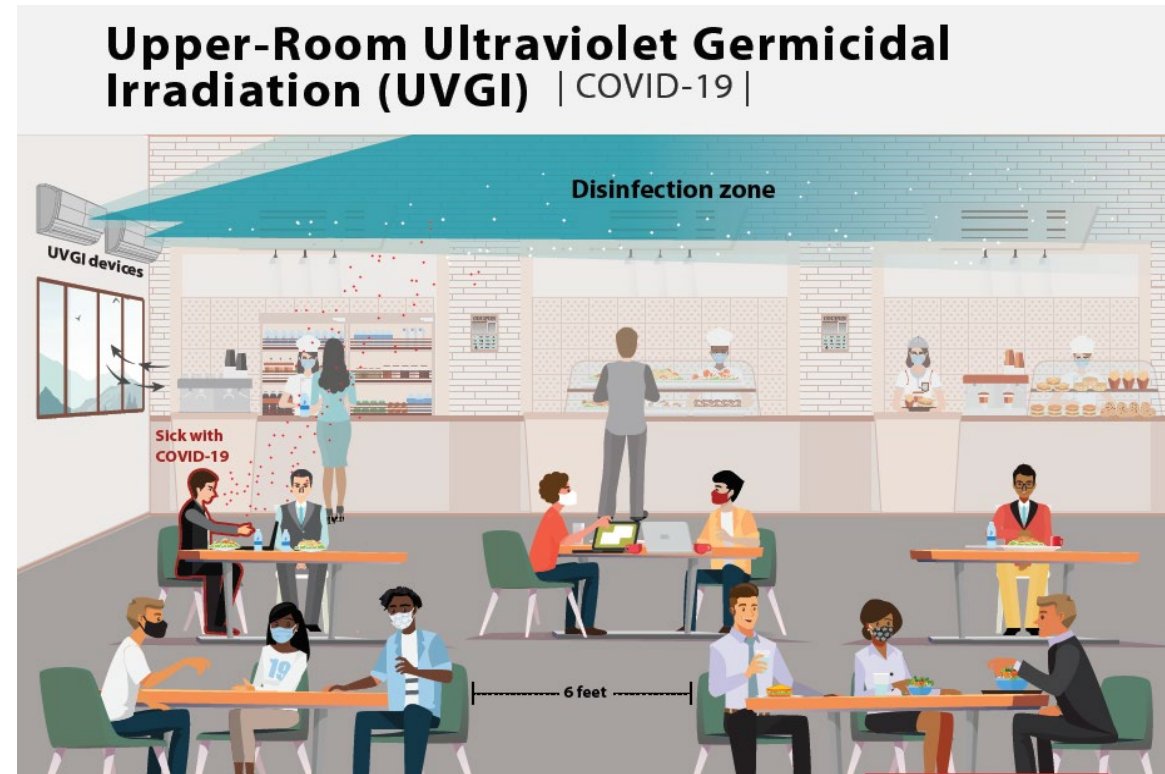
This is where UV-C can offer enhanced disinfection solutions



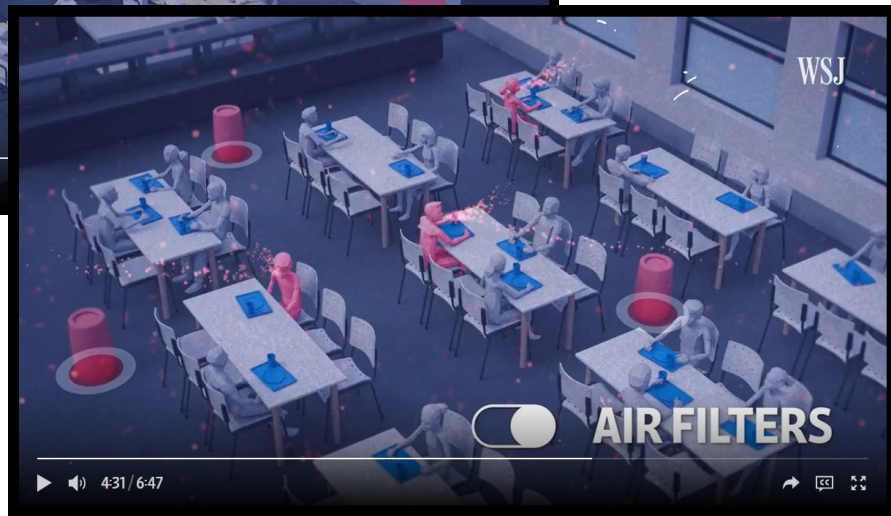
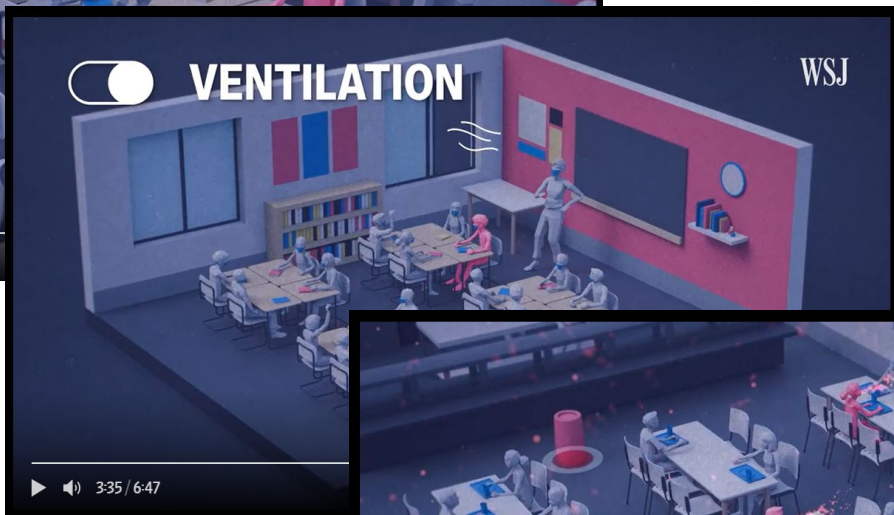
# CDC Guidelines on Upper-Air UVC

## Considerations for Use of Upper-Room UVGI

- The most important locations for UVGI are high-risk indoor settings. These include:
  - Areas with an increased likelihood of sick people (for example, school nurse's office, hospital waiting room).
  - Crowded spaces, particularly when the health status of occupants is unknown (for example, courtrooms, lobbies, homeless shelter sleeping areas).
  - Spaces where people must take off masks to eat or drink (for example, school/institutional cafeterias, restaurants, break rooms).
  - Areas where it is difficult to stay at least 6 feet apart from others.



# Wall Street Journal Video



3/18/2021 1:10PM

## How Risky Is the Classroom With Covid-19 Controls in Place?

A year into the coronavirus pandemic, many schools are only partially open for fear they could fuel the spread of the virus. Experts explain what the actual risks are for spreading Covid-19 in schools and how proper controls can change that equation. Illustration: Preston Jessee for The Wall Street Journal



### Video Link:

<https://www.wsj.com/video/how-risky-is-the-classroom-with-covid-19-controls-in-place/A95D4102-25F0-4B26-B5BE-C85B84F9FB2C.html>

# New York Times Video Simulation

The C.D.C. is urging communities to reopen schools as quickly as possible, but parents and teachers have raised questions about the quality of ventilation available in public school classrooms to protect against the coronavirus.

We worked with a leading engineering firm and experts specializing in buildings systems to better understand the simple steps schools can take to reduce exposure in the classroom.

The students are wearing masks, but their breath still circulates and mixes around the room. About 3 percent of the air each person in this room breathes was exhaled by other people.

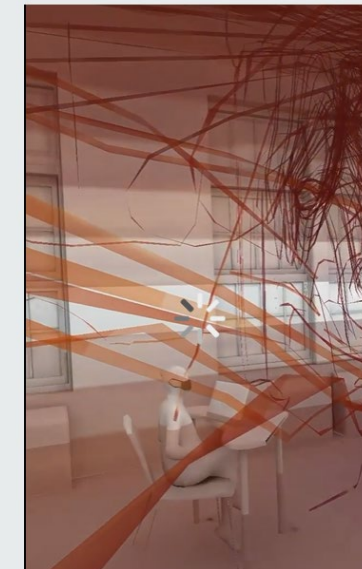
Step inside a classroom with augmented reality to see where contaminants spread.

## Article Link:

<https://www.nytimes.com/interactive/2021/02/26/science/reopen-schools-safety-ventilation.html?searchResultPosition=2>

## Key Takeaways/Observations:

- Simulations continue to show how contaminated air flows in the upper air regions of a space



This augmented reality experience puts you inside an airflow simulation. See how ventilation changes how contaminants can spread indoors.

To experience this in your space, you will need the Instagram app.

To view on Instagram, open the camera on your device and point to the QR tag below.





Signify

Why UV-C

vs.

other disinfection solutions



## New Research Article:

*Air Disinfection for Airborne Infection Control with a Focus on COVID-19: Why Germicidal UV is Essential†*

Edward A. Nardell\*

Division of Global Health Equity,  
Brigham & Women's Hospital, **Harvard  
Medical School, Boston, MA**

Received 7 January 2021, accepted 16  
March 2021, DOI: 10.1111/php.13421

\*Corresponding author email: enardell@gmail.com (Edward A. Nardell)

†This article is part of a Special Issue dedicated to the topics of Germicidal Photobiology and Infection Control

© 2021 American Society for Photobiology

## Excerpt from article Abstract

- *“Only two established room-based technologies are available to **supplement** mechanical ventilation: **portable room air cleaners and upper room germicidal UV** air disinfection.”*
- *“SARS-CoV-2 is highly susceptible to GUV, an 80-year-old technology that has been shown to safely, quietly, effectively and economically produce the equivalent of 10 to 20 or more air changes per hour under real life conditions.”*

## Excerpt from article summary

- *“Quantitatively, where applicable, no other technology approaches the equivalent air changes per hour that can be produced by upper room UV, silently, safely and cost-effectively.”*

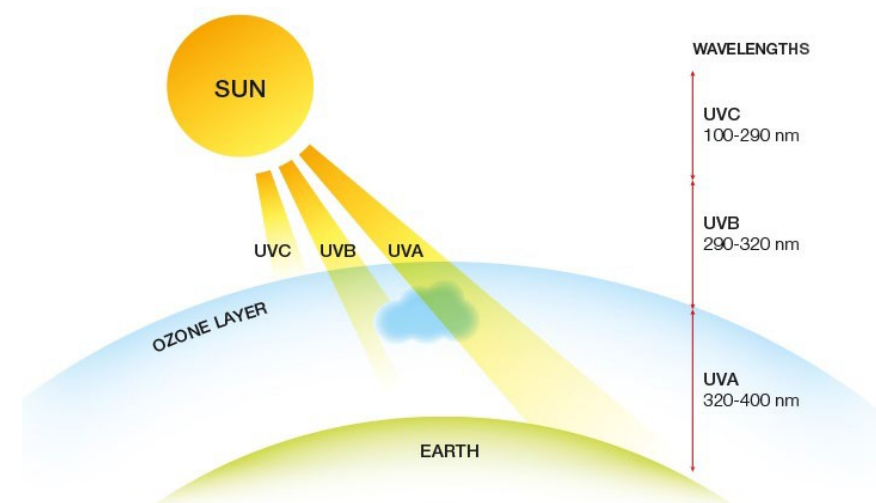
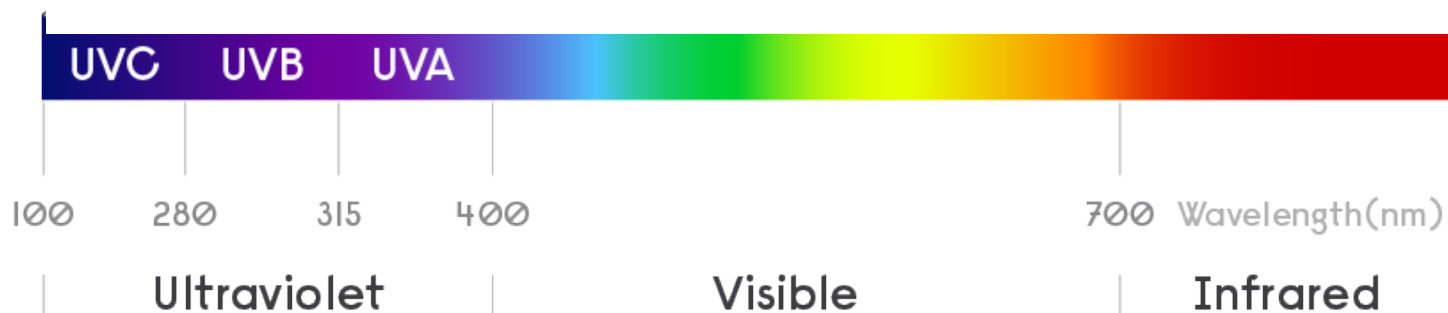
©ignify

What is UV-C  
&  
how does it work?

# What is UV-C?

UV stands for Ultraviolet. It is a wavelength of light that is invisible to human eyes. UV light can be subdivided into three categories:

UV-C 200 to 280 nm	UV-B 280 to 315 nm	UV-A 315 to 400 nm
For disinfection purposes and germicidal application	For medical use (i.e. phototherapy to treat skin conditions, including psoriasis)	For use with curing, suntanning, and insect traps



# Types of commercially available UV Light

## (Far – UV)

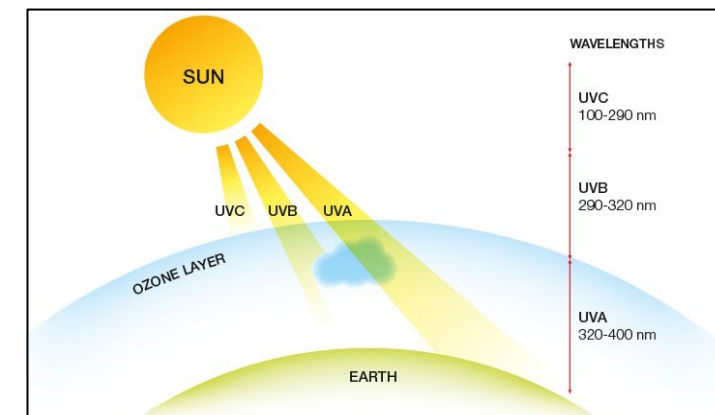
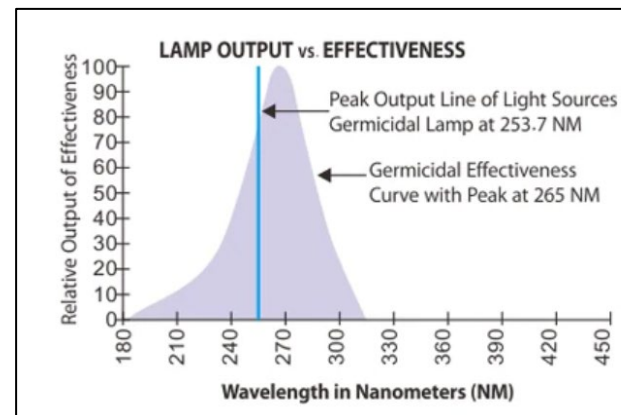
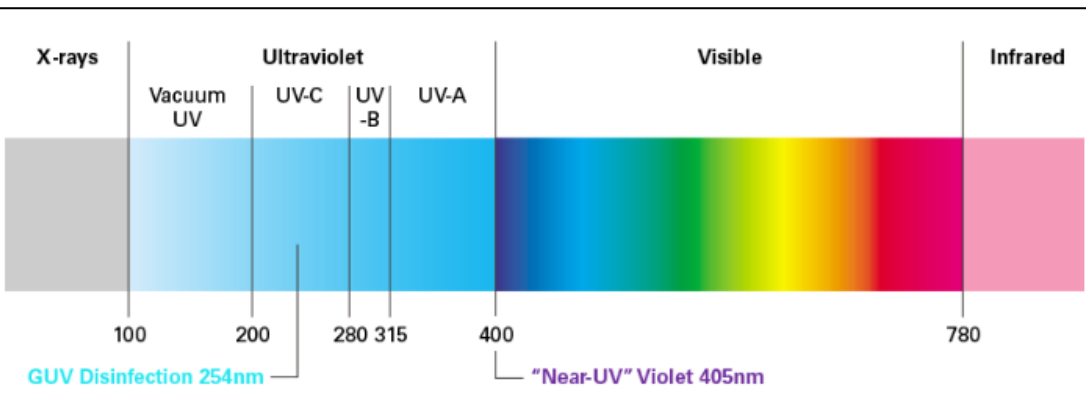
- 222nm
- Not visible light
- Kills bacteria
- Virus effect being tested
- Does not kill Mold, Fungi
- *Exposure time is long*
- Lower exposure and ozone risks
- Technology Infancy
- *UL safety requirements same as 254nm*

## Germicidal UV-C (GUV)

- 254nm
- Not visible light
- Kills bacteria & Inactivates viruses
- Kills mold and fungi
- Exposure time is short
- Highly effective
- Proven technology
- Exposure risk well documented

## (Near – UV)

- 405 nm
- Visible light
- *Limited virus effect*
- Impacts on Mold and Fungi still being researched
- Slows bacteria growth
- *Requires long exposure time*





# Types of commercially available UV Light

## (Far – UV)

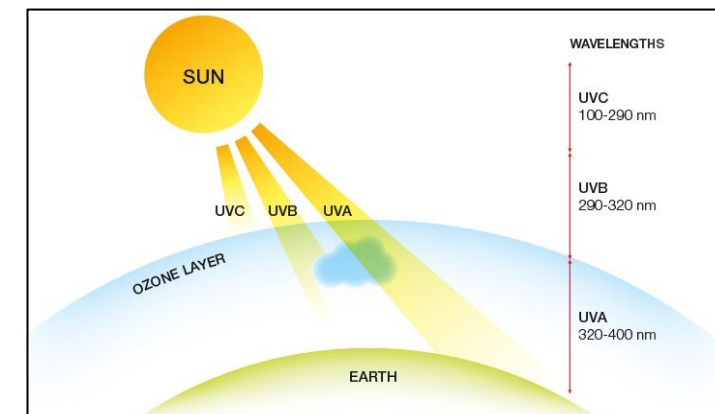
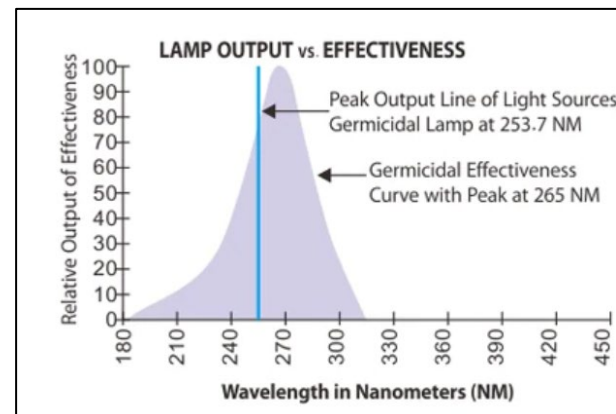
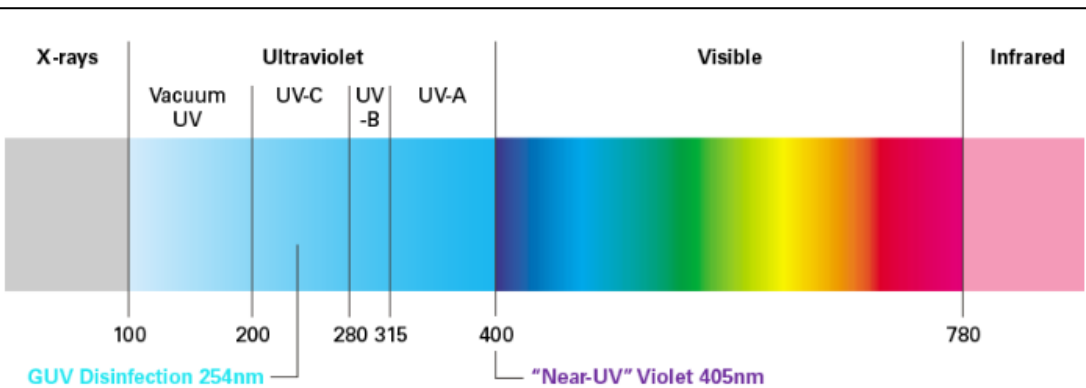
- 222nm
- Not visible light
- Kills bacteria
- Virus effect being tested
- Does not kill Mold, Fungi
- *Exposure time is long*
- Lower exposure and ozone risks
- Technology Infancy
- *UL safety req's updated, limited exposure*

## Germicidal UV-C (GUV)

- 254nm
- Not visible light
- Kills bacteria & Inactivates viruses
- Kills mold and fungi
- Exposure time is short
- Highly effective
- Proven technology
- Exposure risk well documented

## (Near – UV)

- 405 nm
- Visible light
- *Limited virus effect*
- Impacts on Mold and Fungi still being researched
- Slows bacteria growth
- *Requires long exposure time*



# Types of commercially available UV Light

## (Far – UV)

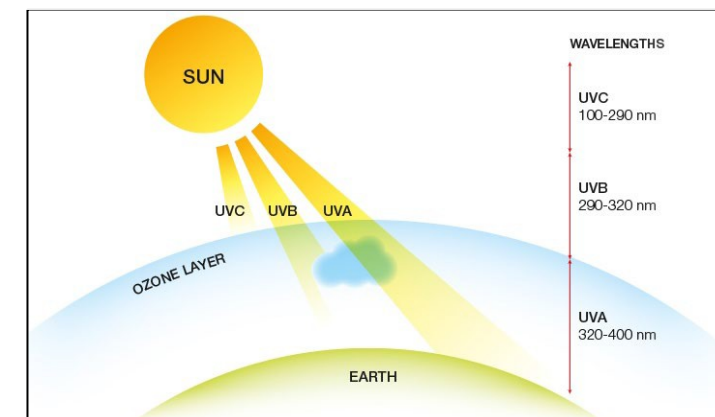
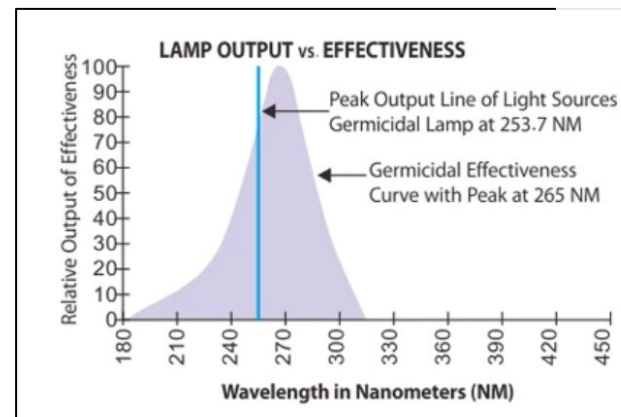
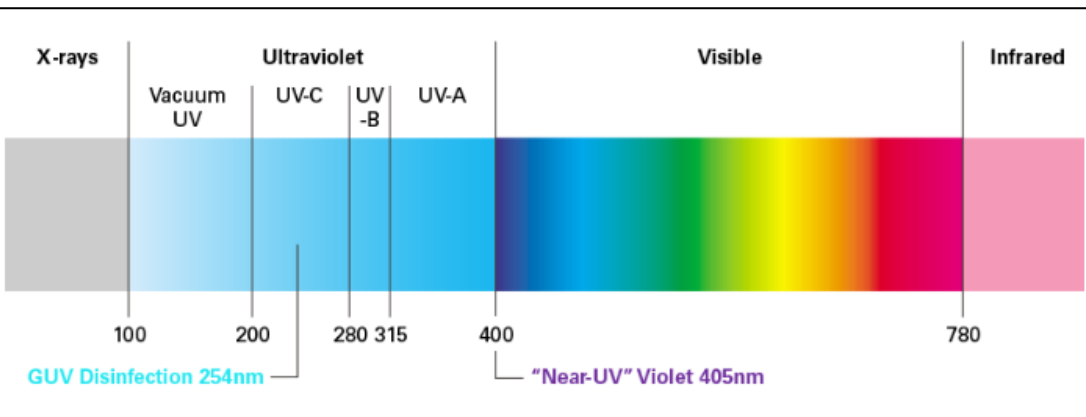
- 222nm
- Not visible light
- Kills bacteria
- Virus effect being tested
- Does not kill Mold, Fungi
- *Exposure time is long*
- Lower exposure and ozone risks
- Technology Infancy
- *UL safety requirements same as 254nm*

## Germicidal UV-C (GUV)

- 254nm
- Not visible light
- Kills bacteria & Inactivates viruses
- Kills mold and fungi
- Exposure time is short
- Highly effective
- Proven technology
- Exposure risk well documented

## (Near – UV)

- 405 nm
- Visible light
- *Limited virus effect*
- Impacts on Mold and Fungi still being researched
- Slows bacteria growth
- *Requires long exposure time*



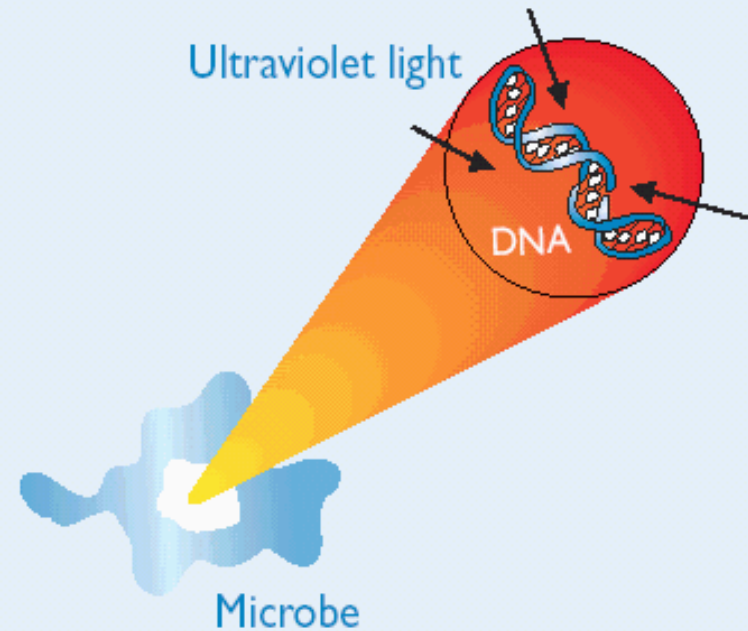
## How does UV-C work?

- UV-C can breakdown the DNA and RNA of bacteria, viruses and spores – **leaving them harmless.**
- To date, there are no known micro-organism that are resistant to UVC.<sup>1</sup>
- The peak output of traditional technology germicidal **UV-C products is (254nm)** which is close (80-85%) to the maximum effectiveness of **UV-C (260-265nm)**

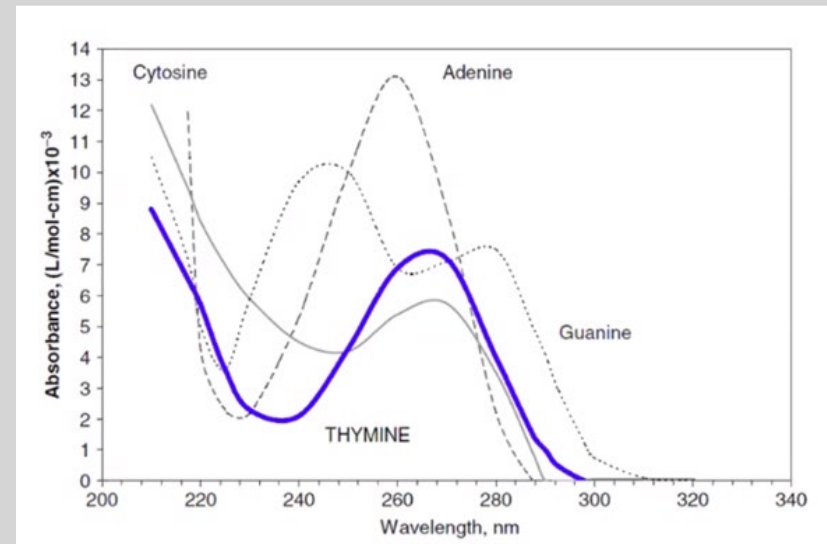
**Used extensively by scientists for over 40 years<sup>2</sup>, UV-C is a known disinfectant for air, surfaces and water**

<sup>1</sup> Fluence (UV Dose) Required to Achieve Incremental Log Inactivation of Bacteria, Protozoa, Viruses and Algae Revised, updated and expanded by Adel Haji Malayeri, Madjid Mohseni, Bill Cairns and James R. Bolton. With earlier contributions by Gabriel Chevretils (2006) and Eric Caron (2006) With peer review by Benoit Barbeau, Harold Wright (1999) and Karl G. Linden

<sup>2</sup>EPA Report, "Building Retrofits for Increased Protection Against Airborne Chemical and Biological Releases" Pg. 56



Effectiveness of UV-C on DNA building blocks



©ignify

# Disinfection Products





**Products**

**Air**

**UVC upper air Ceiling mount**



**UVC upper air wall mount**



**Surface**

**UVC Strips**



**UVC Highbays**



**Controls for Surface**



**Equipment**

**UV-C Chambers**





# Air Disinfection

Upper Air Luminaires

# Testimonials

*“We are aware that UV-C Wavelengths attack the microorganisms at molecular level, inactivating and destroying the contaminants. Therefore, this is part of our overall strategy. We have installed in our office upper-room disinfection luminaires, which are used because of the surrounding people working within the facility, installed at a height that prevents exposure to the UV-C light source.”*

- Stephen Burke, Construction Director, Forte Partners





## EDEKA Clausen Hamburg, Germany

- With the Coronavirus pandemic present, shopping brings some challenges. The last thing you would need, is to worry about your health and safety during shopping.
- The need for disinfection options - in particular for indoor air, but also for surfaces and equipment has increased significantly.
- A challenge that was faced by EDEKA Clausen supermarket in Hamburg to provide additional safety of customers and employees.
- EDEKA Clausen is the first supermarket in Germany to deliver an additional layer of protection with 31 Philips UV-C disinfection upper air luminaires installed to cover 1,315.70m<sup>2</sup> large branch in Hamburg.
- As the upper air devices are equipped with shielding and optics to prevent exposure to UV-C radiation, employees can safely fill the shelves, and customers do their grocery shopping.





## Coffee Beans – Korea

- With the Coronavirus pandemic present, outing brings its own challenges. The last thing you would need, is to worry about your health and safety during going out for wine and dine.
- The need for disinfection options - in particular for indoor air, but also for surfaces and equipment has increased significantly.
- A challenge that was faced by Coffee Beans Retail outlets in Korea to provide additional safety of customers and employees.
- Coffee Beans has 600 retail stores in Korea and plans to provide an additional layer of protection with Philips UV-C disinfection upper air luminaires installed in their first pilot store.
- As the upper air devices are equipped with shielding and optics to prevent exposure to UV-C radiation, employees can safely fill the shelves, and customers do enjoy their coffee with a piece of mind.





# Upper Air Disinfection

(Commercially available off-the-shelf, following installation safety guidelines & commissioning protocols)



Extended Duration



Close Proximity



Common Areas

## ALKCO

### Germicidal UV 2x2 Grid Ceiling Mount



## ALKCO

### Germicidal UV Louvered Wall Mount





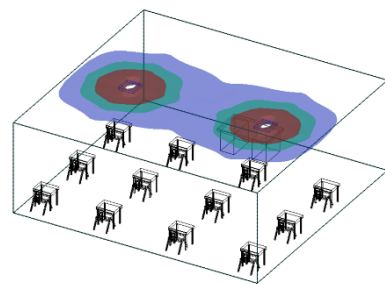
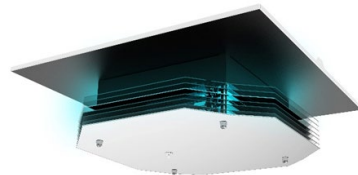
## UV-C Solutions for Upper Air Disinfection



### 2x2 Ceiling Mount

#### General Design Guidelines\*

- Minimum 9' Ceiling Height
- Minimum 12' distance between fixtures
- Minimum 6' distance between fixture and wall
- Estimate of minimum 250sqft area of disinfection per fixture



### 2x2 Ceiling Mount

#### Product Specification:

- Available 2x2 Grid ceiling mount housing
- 4 lamp 9 W PL-S Philips TUV
- White or black polyester powder coated steel housing



*Video Duration: 1-min*



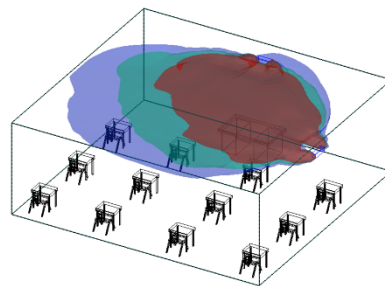
## UV-C Solutions for Upper Air Disinfection



### Louvered Wall Mount

#### General Design Guidelines\*

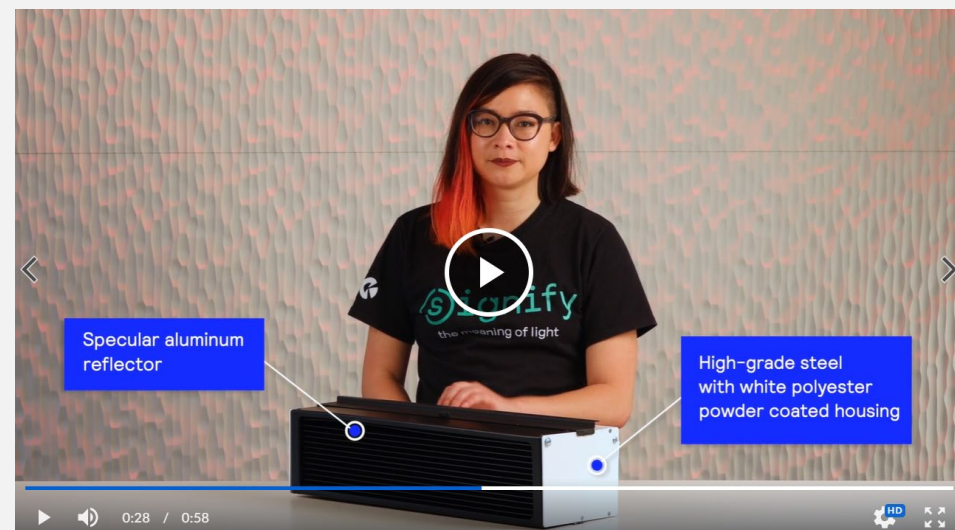
- Minimum 9'6" ceiling
- Minimum 8' 3" mounting height to bottom of fixture
- Minimum spacing between fixtures is 8'
- Recommended to not have obstructions or walls less than 20' in front of fixture
- Estimate of minimum 325sqft area of disinfection per fixture



### Louvered Wall Mount

#### Product Specification:

- Available 22" white polyester powder coated housing (black optional)
- 1 lamp 20 W T5 Philips TUV
- Specular aluminum reflector
- Wall mounting plate provided



**Video Duration: 1-min**



# Upper Air Applications

Upper air disinfection for large areas and spaces where freestanding units are not viable

Restrooms



Classrooms



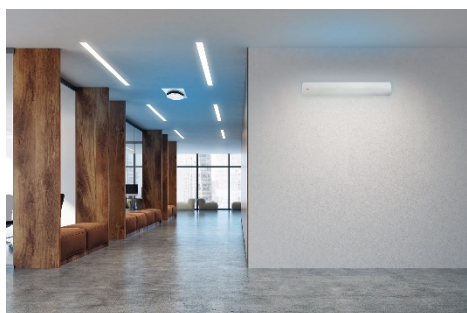
Athletic Facilities



Gymnasiums



Hallways



Cafeteria



Library



Break-out Rooms





# Surface Disinfection

Direct Luminaires



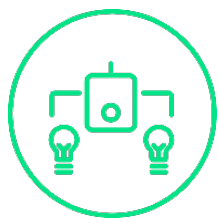
# Spolem Stores Ozorków, Poland

- To reduce the risk of spreading the virus, UV-C disinfection upper air devices were mounted on the ceilings. These continually emit UV-C radiation in the upper part of the store while still allowing customers to carry on shopping during their operation.
- To disinfect surfaces, UV-C battenes were installed, which are automatically activated at night when no one is present. The whole installation was carried out to the highest standards and UV-C radiation is measured to ensure maximum efficacy and safety
- UV-C disinfection devices reduce the risk of contamination to customers and employees of “Spolem” stores and increase the safety and comfort of shopping. We believe the investment in Philips UV-C disinfection devices confirms the quality and the credibility of our brand - especially in such a difficult situation as the coronavirus pandemic. “Agnieszka Derlecka, President of “Spolem” stores, Ozorków



# Direct Luminaires Surface Disinfection

(Controls & commissioning services required to meet UL guidelines)



Controls  
Required



**ALKCO**

Germicidal UV  
High Bay



**ALKCO**

Germicidal UV  
Strip





# Surfaces

Surface disinfection as part of a multi-step mitigation approach to reducing bacterial and viral transmissions

Restrooms



Athletic Facilities  
(lockeroom)



Gymnasiums



Break-out Rooms





©ignify

Equipment

Shared Equipment  
Disinfection Chambers

# Once BioShift<sup>®</sup> germicidal chamber – Shared Equipment Disinfection

## Small chamber



- 254 nm UV-C
- 20W (4 UV-C lamps)
- 530 L x 495 W x 495 H mm
- 50 kg
- ideal for daily disinfection of pathogens on everyday items

## Large chamber



- 254 nm UV-C
- 40W (18 UV-C lamps)
- 1119 L x 535 W x 1695 H mm
- 180 kg
- Ideal for facilities or entrances with a higher volume of people or devices

- Effective
- Easy-to-use
- Properly sealed
- Immediate
- Durable

Deactivates a wide range of pathogens in a recommended time of 5 minutes.



### Application areas:

All indoor applications:  
Faculty, Library, Athletic, and Laboratory Equipment





# Usage Guidelines

UL, Commissioning, & Controls

## UL Certification Compliance

*Ensuring a safe application*

*Underwriters Laboratories has developed a set of standards solely for the purpose of establishing requirements for the safe and effective installation and operation of UV-C luminaires and solutions.*



## UL 1598 Safety Certified Germicidal UV system

***Compliance on measurement technique to ensure safety***

- ✓ Measurement in accordance with IEC 62471
- ✓ Defining the risk group as per IEC TR 62471-2
- ✓ Guidance on minimum mounting height
- ✓ Peak emission value irradiance measurement to assist installers with site planning.
- ✓ Requisite labeling and installation instructions.
- ✓ Guidance instructions on installation, operation, maintenance, and personal protective equipment for service personal in line with UL regulations
- ✓ Specify installer site planning responsibilities.

***Testing requirement : The equipment shall be offset from its intended mounting surface angle by 1 degrees whenever such an offset is likely to produce a more severe test result***

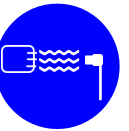




# Upper Air – Installation Commissioning Guide



## General Instructions and Materials Required



## Step 01: Establish Baseline



## Step 02: Eye Level Safety measurements



## Step 03: Documentation and Deliverables



## Final Notes and Appendices

### General Instructions and Materials Required

#### Upper Air Germicidal UV radiation measurements must be taken:

- Upon initial installation
- Whenever new lamps are installed
- Whenever modifications are made to the room or upper air installation conditions (e.g. height, surface, change of floor, ceiling height, room dimensions, layout, etc.)
- Whenever any reports or complaints of possible overexposure are received or reasonably expected



#### Required Materials

- Personal protective equipment (PPE)
  - Safety glasses with side shields
  - Long sleeves shirt, long pants, and closed shoes
  - Shin protectors
  - Comb or hairbrush
  - Hand sanitizer
  - Waterproof watch
- Calibrated X1-F Opmeter – Oigehertz – Optik
  - Step 1: For output reading 1500µW/cm², calibrated at first decimal (0.1µW/cm²)
- Measuring tape and documentation materials
- Ladder and Tripod



### Premeasurement Actions

- Prior to the installation, Signify recommends 100hr burn-in of the lamps. Once the burn-in is complete, the lamps will be stable and considered a basis for commissioning measurements. Failure to complete the 100hr burn-in could result in higher initial readings. The space should never be occupied by humans or pets prior to completing all measurements.
- Make sure you have the latest site documents including latest architectural and electrical drawings, simulated calculation report (if performed), list of surface materials and reflectance values (see Appendix B), site audit notes or previous measurements (if applicable) to compare with the current situation.
- Check if the usage of the space (occupant tasks, hours occupied, etc.) is the same as it was when the system was designed. If there is a change, register it.

### Step 01: Establish Baseline



#### Instructions for Measuring

- Acquire all necessary PPE.
- Zero the UV meter according to the meter manufacturer's instructions.
- Remove the cap and position the sensor 8ft (0.91m) from the center of the upper-room GUV luminaire.
- Point the sensor probe vertically, aiming in the beam of the luminaire, the center of the sensor should be in the center of the UV-C beam.
- Record the reading in the log book, this is the initial baseline output to be referenced by all future readings after replacement lamps are installed.
- Repeat steps 1-5 at 6ft (1.83m) from the center of the upper-room GUV luminaire.
- If measuring during relamping and/or after installation, compare results to baseline measurements. If value is less than baseline reading, take corrective action by cleaning the lamp and fixture. If value is more than baseline reading, make sure proper wattage lamp is being installed.<sup>1,2</sup>

Note: Upon luminaire relamping and/or cleaning, changes to site conditions (painting, installation of new furniture in the irradiance path, changing or reconfiguring reflective surfaces, installation of obstructions in the irradiance path, etc.) and/or changes to site usage, repeat step 1-7.

### Step 02: Eye Level Safety measurements

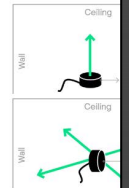
#### Instructions for Measuring

- Create a grid of measurements on the floor, placing the tripod at an equally-spaced distance (see table to the right).
- Place the tripod head at the default 6ft (1.83m) or acceptable eye level for the tasks that take place in the space.
- Make sure to use the 80° field of view detector or the detector for these measurements.
- At each grid point, take five measurements
  - For the first measurement, orient the detector (normal of the detector surface) horizontally (pointed at ceiling).
  - Next, orient the detector vertically, pointing straight ahead along the typical line of sight for measurement in all directions (north, east, south, west).
- Record the location of all measured points, clearly highlight if any measurement is higher than the maximum agreed upon value for the application (based on the Maximum Permissible UV-C Exposure guidelines in Appendix A).<sup>3</sup> Corrective action needs to be taken and system should not be released for use until measurements are in alignment with Appendix A dosage recommendations.

#### Measurements

Space Length (ft/m)	Maximum grid spacing (ft/m)
<6ft/1.83m	1.5ft/0.5m
6-24ft/2-7.5m	3ft/0.9m
24-60ft/7.5-20m	5.5ft/1.5m
>60ft/20m	8ft/2.4m

#### Sensor Orientation



### Step 03: Documentation and Deliverables



- Measurement / Electrical final check report (reporting if the luminaires were correctly installed, following manufacturer's instructions and design additions).
- Visual / photographic inspection (documenting all relevant notes during the audit and on-going).
- Final site release report (to be filled on record and send records in 1.5, 7.5, 15, 30, 60, 90, 120, 180, 240, 300, 360, 420, 480, 540, 600, 660, 720, 780, 840, 900, 960, 1020, 1080, 1140, 1200, 1260, 1320, 1380, 1440, 1500, 1560, 1620, 1680, 1740, 1800, 1860, 1920, 1980, 2040, 2100, 2160, 2220, 2280, 2340, 2400, 2460, 2520, 2580, 2640, 2700, 2760, 2820, 2880, 2940, 3000, 3060, 3120, 3180, 3240, 3300, 3360, 3420, 3480, 3540, 3600, 3660, 3720, 3780, 3840, 3900, 3960, 4020, 4080, 4140, 4200, 4260, 4320, 4380, 4440, 4500, 4560, 4620, 4680, 4740, 4800, 4860, 4920, 4980, 5040, 5100, 5160, 5220, 5280, 5340, 5400, 5460, 5520, 5580, 5640, 5700, 5760, 5820, 5880, 5940, 6000, 6060, 6120, 6180, 6240, 6300, 6360, 6420, 6480, 6540, 6600, 6660, 6720, 6780, 6840, 6900, 6960, 7020, 7080, 7140, 7200, 7260, 7320, 7380, 7440, 7500, 7560, 7620, 7680, 7740, 7800, 7860, 7920, 7980, 8040, 8100, 8160, 8220, 8280, 8340, 8400, 8460, 8520, 8580, 8640, 8700, 8760, 8820, 8880, 8940, 9000, 9060, 9120, 9180, 9240, 9300, 9360, 9420, 9480, 9540, 9600, 9660, 9720, 9780, 9840, 9900, 9960, 10020, 10080, 10140, 10200, 10260, 10320, 10380, 10440, 10500, 10560, 10620, 10680, 10740, 10800, 10860, 10920, 10980, 11040, 11100, 11160, 11220, 11280, 11340, 11400, 11460, 11520, 11580, 11640, 11700, 11760, 11820, 11880, 11940, 12000).
- All documentation shall be made available to all parties involved (architect, engineering contractor, contractor, owner, and used in a secure location for future reference).

### Final Notes and Appendices

#### Dosing Recommendation

Maximum permissible UVC exposure

This table is based on standard dosimetry for a 100% maximum permissible UVC exposure relative to the level and permissible UVC exposure shall not exceed the ACGLL. For more information, visit the calculator for 8-hour day at: [www.signify.com/uv-c](http://www.signify.com/uv-c)

Maximum permissible UVC exposure for radiation at 254 nm

Exposure time	UVC irradiance (µW/cm²)
24 hours	0.02
12 hours	0.03
8 hours	0.04
6 hours	0.07
4 hours	0.14
2 hours	0.28
1 hour	0.56
30 minutes	1.12
15 minutes	2.24
5 minutes	7.36
1 minute	23.04
30 seconds	70.08
15 seconds	210.24
10 seconds	315.36
5 seconds	630.72
1 second	1261.44

Threshold Limit Value (TLV) concentration shall be based on new-time occupancy of spaces. For design, this maximum radiation is supported by a maximum occupancy rate of 1 person per 100 sq ft (9.3 sq m) for 8-hour day. This maximum radiation is supported by a maximum occupancy rate of 1 person per 100 sq ft (9.3 sq m) for 8-hour day. This maximum radiation is supported by a maximum occupancy rate of 1 person per 100 sq ft (9.3 sq m) for 8-hour day.

UVC radiation reflectance

Material	Ref. (%)	Ref. (0)	Ref. (1)
Aluminum	40-50	0.00000000	0.00000000
Aluminum surface	40-50	0.04000000	0.04000000
Aluminum (oxidized)	40-50	0.00000000	0.00000000
Aluminum (polished)	40-50	0.00000000	0.00000000
Aluminum (anodized)	40-50	0.00000000	0.00000000
Aluminum (black)	40-50	0.00000000	0.00000000
Aluminum (white)	40-50	0.00000000	0.00000000
Aluminum (gray)	40-50	0.00000000	0.00000000
Aluminum (red)	40-50	0.00000000	0.00000000
Aluminum (blue)	40-50	0.00000000	0.00000000
Aluminum (green)	40-50	0.00000000	0.00000000
Aluminum (yellow)	40-50	0.00000000	0.00000000
Aluminum (purple)	40-50	0.00000000	0.00000000
Aluminum (brown)	40-50	0.00000000	0.00000000
Aluminum (pink)	40-50	0.00000000	0.00000000
Aluminum (orange)	40-50	0.00000000	0.00000000
Aluminum (black)	40-50	0.00000000	0.00000000
Aluminum (white)	40-50	0.00000000	0.00000000
Aluminum (gray)	40-50	0.00000000	0.00000000
Aluminum (red)	40-50	0.00000000	0.00000000
Aluminum (blue)	40-50	0.00000000	0.00000000
Aluminum (green)	40-50	0.00000000	0.00000000
Aluminum (yellow)	40-50	0.00000000	0.00000000
Aluminum (purple)	40-50	0.00000000	0.00000000
Aluminum (brown)	40-50	0.00000000	0.00000000
Aluminum (pink)	40-50	0.00000000	0.00000000
Aluminum (orange)	40-50	0.00000000	0.00000000
Aluminum (black)	40-50	0.00000000	0.00000000
Aluminum (white)	40-50	0.00000000	0.00000000
Aluminum (gray)	40-50	0.00000000	0.00000000
Aluminum (red)	40-50	0.00000000	0.00000000
Aluminum (blue)	40-50	0.00000000	0.00000000
Aluminum (green)	40-50	0.00000000	0.00000000
Aluminum (yellow)	40-50	0.00000000	0.00000000
Aluminum (purple)	40-50	0.00000000	0.00000000
Aluminum (brown)	40-50	0.00000000	0.00000000
Aluminum (pink)	40-50	0.00000000	0.00000000
Aluminum (orange)	40-50	0.00000000	0.00000000
Aluminum (black)	40-50	0.00000000	0.00000000
Aluminum (white)	40-50	0.00000000	0.00000000
Aluminum (gray)	40-50	0.00000000	0.00000000
Aluminum (red)	40-50	0.00000000	0.00000000
Aluminum (blue)	40-50	0.00000000	0.00000000
Aluminum (green)	40-50	0.00000000	0.00000000
Aluminum (yellow)	40-50	0.00000000	0.00000000
Aluminum (purple)	40-50	0.00000000	0.00000000
Aluminum (brown)	40-50	0.00000000	0.00000000
Aluminum (pink)	40-50	0.00000000	0.00000000
Aluminum (orange)	40-50	0.00000000	0.00000000
Aluminum (black)	40-50	0.00000000	0.00000000
Aluminum (white)	40-50	0.00000000	0.00000000
Aluminum (gray)	40-50	0.00000000	0.00000000
Aluminum (red)	40-50	0.00000000	0.00000000
Aluminum (blue)	40-50	0.00000000	0.00000000
Aluminum (green)	40-50	0.00000000	0.00000000
Aluminum (yellow)	40-50	0.00000000	0.00000000
Aluminum (purple)	40-50	0.00000000	0.00000000
Aluminum (brown)	40-50	0.00000000	0.00000000
Aluminum (pink)	40-50	0.00000000	0.00000000
Aluminum (orange)	40-50	0.00000000	0.00000000
Aluminum (black)	40-50	0.00000000	0.00000000
Aluminum (white)	40-50	0.00000000	0.00000000
Aluminum (gray)	40-50	0.00000000	0.00000000
Aluminum (red)	40-50	0.00000000	0.00000000
Aluminum (blue)	40-50	0.00000000	0.00000000
Aluminum (green)	40-50	0.00000000	0.00000000
Aluminum (yellow)	40-50	0.00000000	0.00000000
Aluminum (purple)	40-50	0.00000000	0.00000000
Aluminum (brown)	40-50	0.00000000	0.00000000
Aluminum (pink)	40-50	0.00000000	0.00000000
Aluminum (orange)	40-50	0.00000000	0.00000000
Aluminum (black)	40-50	0.00000000	0.00000000
Aluminum (white)	40-50	0.00000000	0.00000000
Aluminum (gray)	40-50	0.00000000	0.00000000
Aluminum (red)	40-50	0.00000000	0.00000000
Aluminum (blue)	40-50	0.00000000	0.00000000
Aluminum (green)	40-50	0.00000000	0.00000000
Aluminum (yellow)	40-50	0.00000000	0.00000000
Aluminum (purple)	40-50	0.00000000	0.00000000
Aluminum (brown)	40-50	0.00000000	0.00000000
Aluminum (pink)	40-50	0.00000000	0.00000000
Aluminum (orange)	40-50	0.00000000	0.00000000
Aluminum (black)	40-50	0.00000000	0.00000000
Aluminum (white)	40-50	0.00000000	0.00000000
Aluminum (gray)	40-50	0.00000000	0.00000000
Aluminum (red)	40-50	0.00000000	0.00000000
Aluminum (blue)	40-50	0.00000000	0.00000000
Aluminum (green)	40-50	0.00000000	0.00000000
Aluminum (yellow)	40-50	0.00000000	0.00000000
Aluminum (purple)	40-50	0.00000000	0.00000000
Aluminum (brown)	40-50	0.00000000	0.00000000
Aluminum (pink)	40-50	0.00000000	0.00000000
Aluminum (orange)	40-50	0.00000000	0.00000000
Aluminum (black)	40-50	0.00000000	0.00000000
Aluminum (white)	40-50	0.00000000	0.00000000
Aluminum (gray)	40-50	0.00000000	0.00000000
Aluminum (red)	40-50	0.00000000	0.00000000
Aluminum (blue)	40-50	0.00000000	0.00000000
Aluminum (green)	40-50	0.00000000	0.00000000
Aluminum (yellow)	40-50	0.00000000	0.00000000
Aluminum (purple)	40-50	0.00000000	0.00000000
Aluminum (brown)	40-50	0.00000000	0.00000000
Aluminum (pink)	40-50	0.00000000	0.00000000
Aluminum (orange)	40-50	0.00000000	0.00000000
Aluminum (black)	40-50	0.00000000	0.00000000
Aluminum (white)	40-50	0.00000000	0.00000000
Aluminum (gray)	40-50	0.00000000	0.00000000
Aluminum (red)	40-50	0.00000000	0.00000000
Aluminum (blue)	40-50	0.00000000	0.00000000
Aluminum (green)	40-50	0.00000000	0.00000000
Aluminum (yellow)	40-50	0.00000000	0.00000000
Aluminum (purple)	40-50	0.00000000	0.00000000
Aluminum (brown)	40-50	0.00000000	0.00000000
Aluminum (pink)	40-50	0.00000000	0.00000000
Aluminum (orange)	40-50	0.00000000	0.00000000
Aluminum (black)	40-50	0.00000000	0.00000000
Aluminum (white)	40-50	0.00000000	0.00000000
Aluminum (gray)	40-50	0.00000000	0.00000000
Aluminum (red)	40-50	0.00000000	0.00000000
Aluminum (blue)	40-50	0.00000000	0.00000000
Aluminum (green)	40-50	0.00000000	0.00000000
Aluminum (yellow)	40-50	0.00000000	0.00000000
Aluminum (purple)	40-50	0.00000000	0.00000000
Aluminum (brown)	40-50	0.00000000	0.00000000</

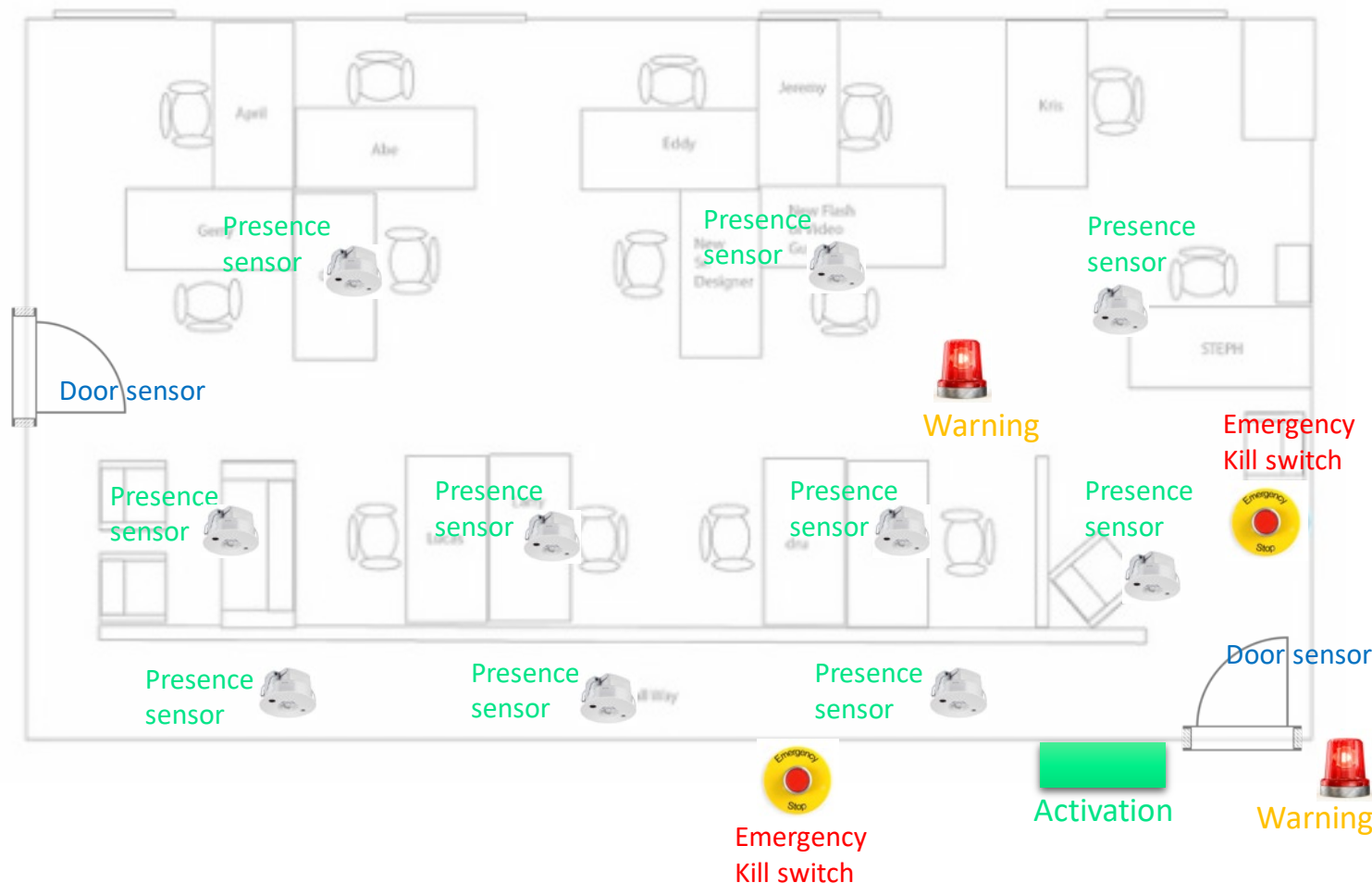
# Direct UV-C Luminaire Controls to Ensure Occupant Safety

## UV-C controls are fitted per room to prevent usage with people present

The responsibility to switch the UV-C lighting ON lies **with an authorized operator.**

### Key UV-C Control Components:

- Authorized Activation Panel
  - Luminaire on/off control
  - Protection checks
  - Status feedback
- Presence sensor: Independent mount
- Door sensor
- Emergency kill switch
- Activation warning (light or sound)



Signify



FROMM