



Benefits of UV-C disinfection technology

*in the context of
the COVID-19 pandemic and beyond*

Our new company name

The Signify logo features a teal '@' symbol inside a teal circle, followed by the word 'signify' in a lowercase, teal, sans-serif font.

Our global product brand

The Philips logo is the word 'PHILIPS' in a bold, blue, sans-serif font.

Our IoT (Internet of Things) brand

The Interact logo is the word 'interact' in a lowercase, red, sans-serif font.

The Color Kinetics logo consists of a black circle with a white 'K' inside, followed by the text 'COLOR KINETICS' and 'Dynamic architecture lighting systems' below it.

The Dynalite logo is the word 'dynalite' in a lowercase, grey, sans-serif font, followed by a yellow and white icon.

The Cooper Lighting Solutions logo features a red and white circular icon, followed by the text 'COOPER' and 'Lighting Solutions' below it.

The Once logo is the word 'once' in a lowercase, black, sans-serif font, with a small registered trademark symbol, and 'A @ignify company' below it.

The Trulifi logo features a green circular icon with a white smile-like shape, followed by the text 'truLifi' and 'by @ignify' below it.

The Hue logo is the word 'hue' in a lowercase, multi-colored, sans-serif font, followed by 'personal wireless lighting' and 'Smart home lighting systems' below it.

The Wiz logo is the word 'WiZ' in a bold, black, sans-serif font.

Signify is the world leader in lighting

We provide high-quality energy efficient lighting products, systems and services

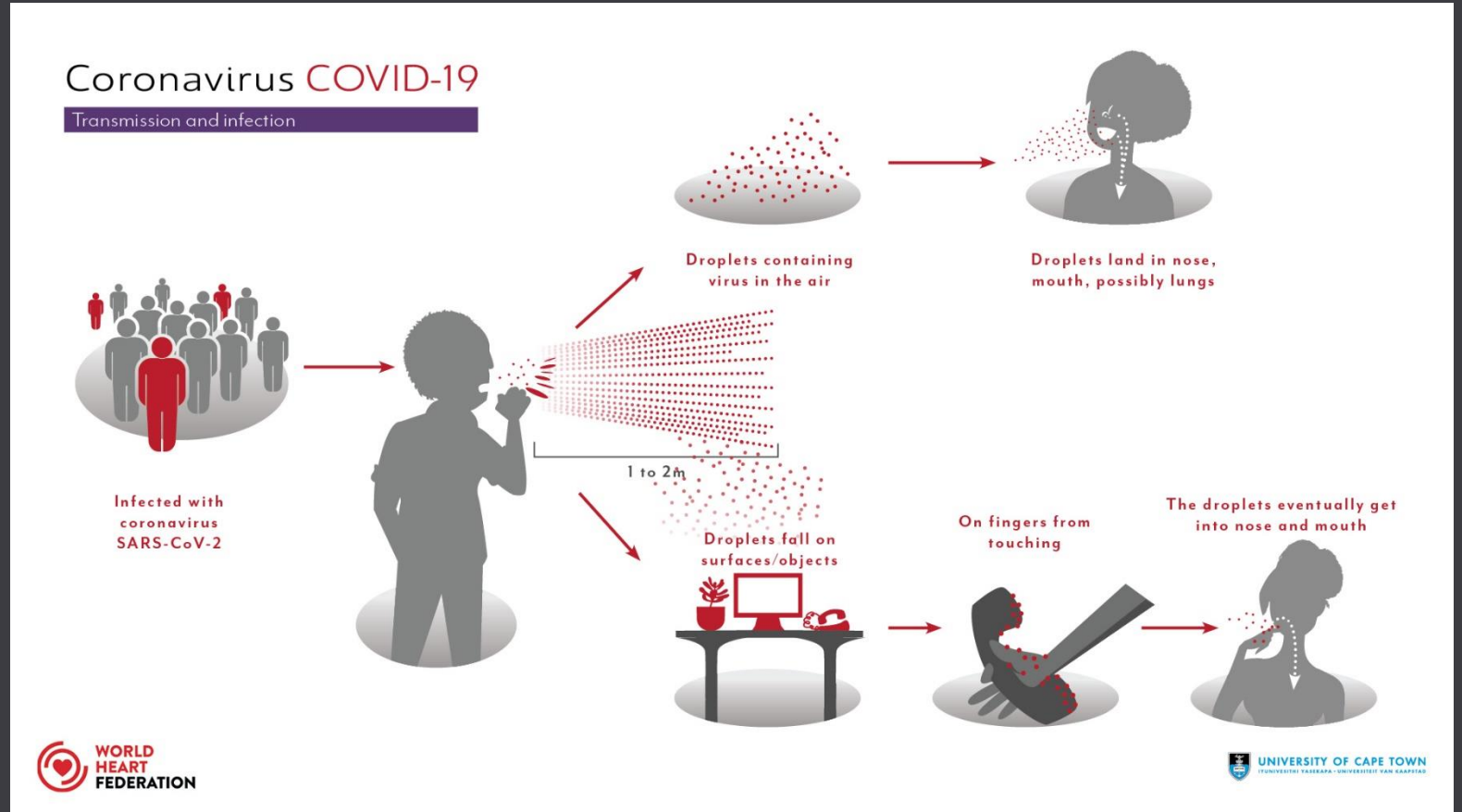
The Signify logo, featuring a teal '@' symbol inside a teal circle, followed by the word 'signify' in a lowercase, teal, sans-serif font.

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**

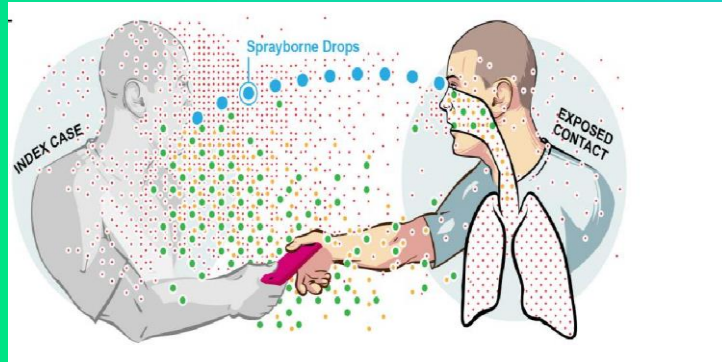
This is where we can offer enhanced disinfection solutions



**Primary infection route of
SARS-CoV-2 is airborne**

Ways the Corona virus is spread 2020 view

Initially, SARS-CoV-2 was seen as a disease spread by **respiratory droplets** and contact with **contaminated surfaces**



Ways the Corona virus is spread 2021 view

Wide acceptance that pandemic is caused by airborne transmission and aerosols play a large role

nature
NEWS FEATURE | 29 JULY 2021
COVID-19 rarely spreads through surfaces. So why are we still deep cleaning?
The consensus behind the pandemic: can begin on doorknobs and other surfaces, but these aren't a major source of infection.

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™
Update 7 May 2021

“Breathing in air when close to an infected person who is exhaling small droplets and particles that contain the virus is a key way the virus is transmitted.”

Aerosol transmission is now widely accepted as the principal way that COVID-19 is spread, as has the importance of ventilation—natural and mechanical. Air Disinfection for Airborne Infection Control with a Focus on COVID-19: Why Germicidal UV is Essential

Edward A. Nardel*
Division of Global Health Equity, Brigham & Women's Hospital, Harvard Medical School, Boston, MA.
Received 7 January 2021; accepted 18 March 2021; DOI: 10.1038/s41591-021-11421-1

systems. Most transmission appears to occur in rooms where both an infectious source COVID-19 case and other susceptible occupants share the same air.

Findings of these studies suggest that the risk of SARS-CoV-2 Infection via the **fomite transmission route is low, and generally less than 1 in 10,000**, which means that each contact with a contaminated surface has less than a 1 in 10,000 chance of causing an infection.



Portal Rasmi

KEMENTERIAN KESIHATAN MALAYSIA

GUIDELINES ON VENTILATION IN THE HEALTHCARE SETTING TO REDUCE THE TRANSMISSION OF RESPIRATORY PATHOGENS

10.2 UVGI (Ultraviolet Germicidal Irradiation)

Ultraviolet germicidal irradiation (UVGI), is a disinfection tool that maybe used as a supplemental air cleaning measure in a healthcare setting. UVGI is effective in reducing the transmission of airborne bacterial and viral infections, but it has only a minimal inactivating effect on fungal spores. The design and sizing of effective UVGI disinfection systems as well as dosage and contact time requires specific knowledge and experience.

a. Upper-room UVGI systems

1. Upper-room UVGI can be used to provide air cleaning within occupied spaces
2. UVGI fixtures mounted on walls or ceilings to create a disinfection zone of UV energy that is focused up and away from people to minimize direct exposure. These fixtures disinfect air as it circulates from mechanical ventilation, ceiling fans, or natural air movement. It requires good vertical air movement in the room.

2. Air disinfection UVGI systems can be effective at applying intense UV energy to inactivate airborne pathogens as they flow within the ACMV duct. Air disinfection systems are often placed downstream of the ACMV coils. This location keeps the coil, drain pan, and wetted surfaces free of microbial growth and also disinfects the moving air.

c. Portable UV-C for terminal room disinfection

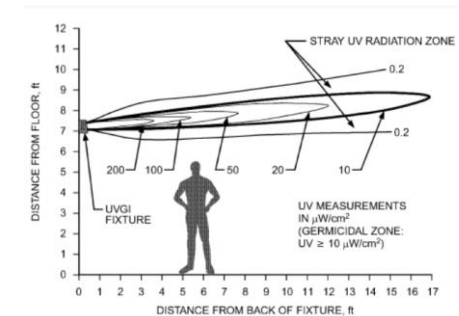
1. May be use as additional strategy for surface disinfection after routine terminal cleaning has been done. It should not replace routine manual cleaning of healthcare environment.



TECHNICAL ADVISORY ON USE OF AIR-CLEANING TECHNOLOGIES TO MITIGATE COVID-19 AEROSOL TRANSMISSION RISK

Upper-room UVGI

Upper-room UVGI systems^[11-12] use UV lamps to create an irradiation zone in the upper portion of the room for inactivation of microorganisms in the air (Figure 2). As the irradiation zone is located above room occupants, such systems avoid direct exposure to UV-C.



UV-C airstream disinfection systems

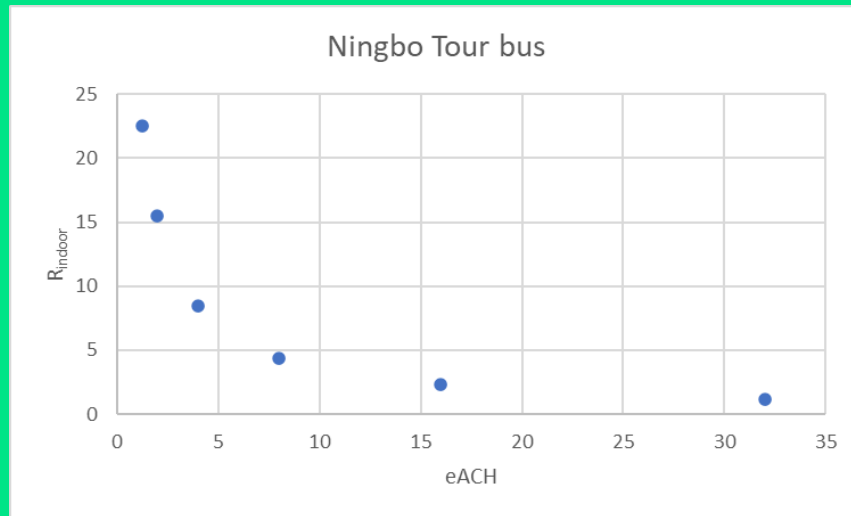
UV-C systems (Figure 3) intended for airstream disinfection are typically installed inside air-handling units (AHUs) or AHU rooms where the lowest maximum air speed in an ACMV system usually occurs, though UV-C systems may also be located in air ducts.^{[7], [11]}

Examples for indoor event settings



Real life example: Ningbo Bus tour, Jan 2020

- During a 2-hour bus journey in Ningbo, China, 23 of 68 passengers were infected
- Seat locations were uncorrelated with distance to index case



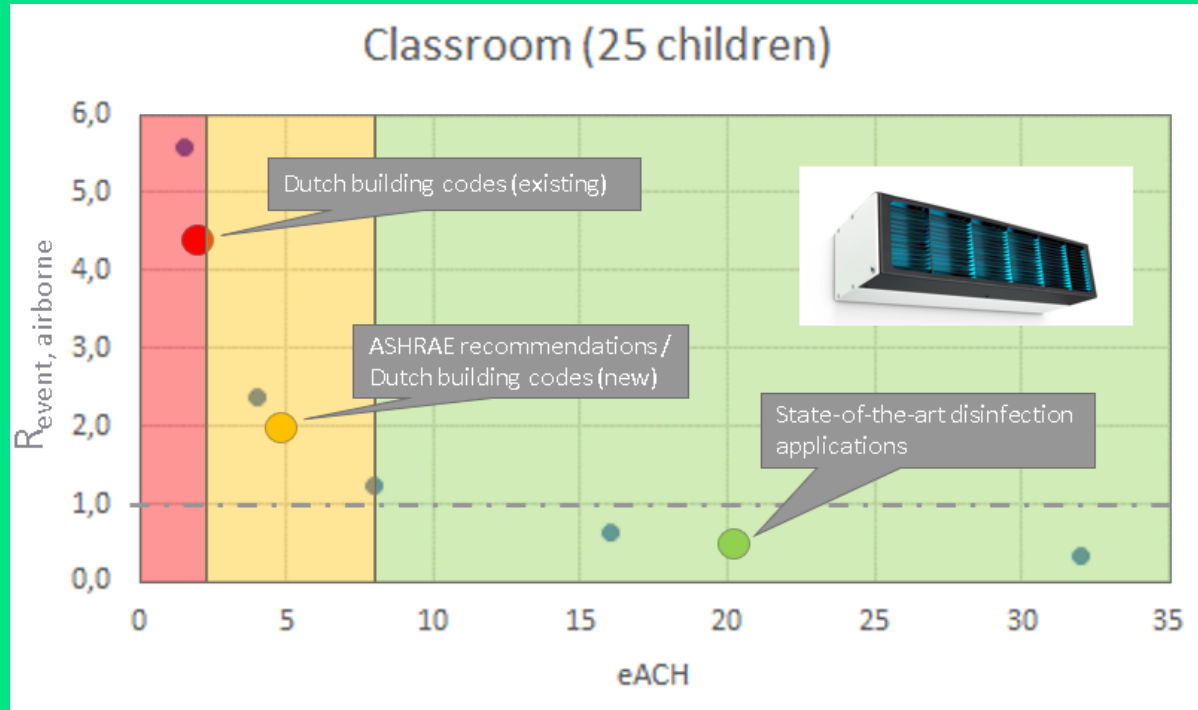
>37 eqACH required for $R_{event, airborne} < 1$

Parameter	
# of infected people	1
# of people (total)	68
Breathing rate (m ³ /hr)	0,5
Quanta/hr (<i>derived</i>)	30
Exposure time (hr)	1,7
ACH (air changes per hour)	1,25
Volume space (m ³)	45
# of people infected	23



Model example: A classroom with 25 children

- Note, this is not a real-life case, but a projection, based on the Wells-Riley model



Already >10 eqACH required just to get $R_{\text{event, airborne}} < 1$

Parameter	
# of infected people	1
# of people (total)	25
Breathing rate (m ³ /hr)	0,4
Quanta/hr (<i>assumed</i>)	25
Exposure time (hr)	6
ACH	1,5
Volume space (m ³)	147
Airborne Infection Probability	23%
Expected # of children infected without extra protection	5-6

Model Examples: office; airplane



Parameter	
# of infectors	1
# of people (total)	19
Breathing rate (m ³ /hr)	0,5
Quanta/hr (<i>assumed</i>)	10
Exposure time (hr)	8
ACH	2
Volume space (m ³)	240
Airborne Infection Probability	7,5%
<i>Expected</i> # of people infected without extra protection	1,4



Photo from Shutterstock

Parameter	
# of infectors	1
# of people (total)	299
Breathing rate (m ³ /hr)	0,5
Quanta/hr (<i>assumed</i>)	10
Exposure time (hr)	2,5
ACH	20
Volume space (m ³)	480
Airborne Infection Probability	0,1%
<i>Expected</i> # of people infected without extra protection	0,4

Higher eqACH levels needed to bring $R_{\text{event, airborne}} \ll 1$

High ACH makes planes indeed relatively safe!

What is UV-C ?

What is UV light?

Ultraviolet (UV) light is invisible to human eyes. It can be subdivided into three categories:

UV-A (from 315 to 400 nm)

- For use with curing, sun tanning and insect traps.

UV-B (from 280 to 315 nm)

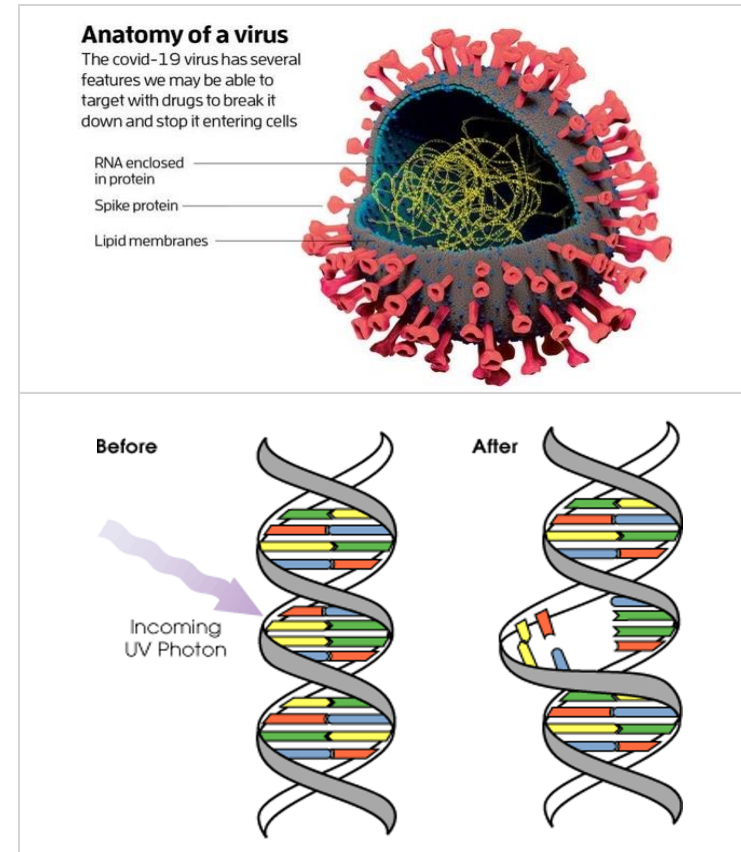
- For medical use (i.e. phototherapy to treat skin conditions, including psoriasis).

UV-C (from 200 to 280 nm)

- For disinfection purposes and germicidal application.

How does it work?

- UV-C radiation can **break the DNA and RNA** of bacteria, viruses and spores, meaning that they leave them harmless. There are **no known micro-organisms resistant to UVC**.
- The **peak output of our germicidal lamps (253.7nm)** is close to the maximum effectiveness of UV-C (265nm)



Why UV-C as Disinfectant ?

Why use UV-C as a disinfectant?



Trusted

UV-C disinfection is a proven technology for over 40 years



Effective

All bacteria and viruses tested to date respond to UV-C disinfection¹



Fast

UV-C can disinfect surfaces and objects in minutes



Versatile

UV-C can be used in numerous applications

Signify and Boston University have validated the effectiveness of our light sources on **inactivating the virus that causes COVID-19**

The **peak output of our germicidal lamps (253.7nm)**

The team applied a dose of 5mJ/cm², resulting in a reduction of the SARS-CoV-2 virus of 99% in 6 seconds. Based on the data, it was determined that a dose of 22mJ/cm² will result in a reduction of 99.9999% in 25 seconds.²



Philips UV-C Offerings ?

Air Disinfection

Object Disinfection

Surface Disinfection



Air Disinfection (Use when people are around 24X7)

UVC upper air ceiling mount



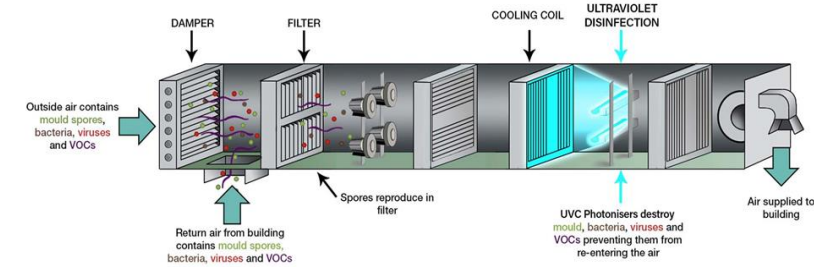
UVC upper air wall mount



UVC portable air disinfection



UVGI for AHU unit





Object disinfection (No leakage of UVC | Completely Safe)

UVC mini guest room chamber



UVC chamber



UVC chamber





Surface disinfection (Use when people are not around)

UVC batten



TMS160C 1X36W
TUV SLV/6



TMS160C 2X36W
TUV SLV/6



TMS160C 1X36W
TUV SLV/6 R



TMS160C 2X36W
TUV SLV/6 R

UVC Luminaire with MW Sensor



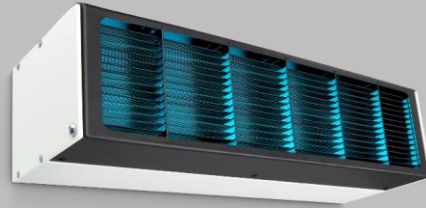
UVC trolley





Offering 1: Upper Air UV-C Luminaire

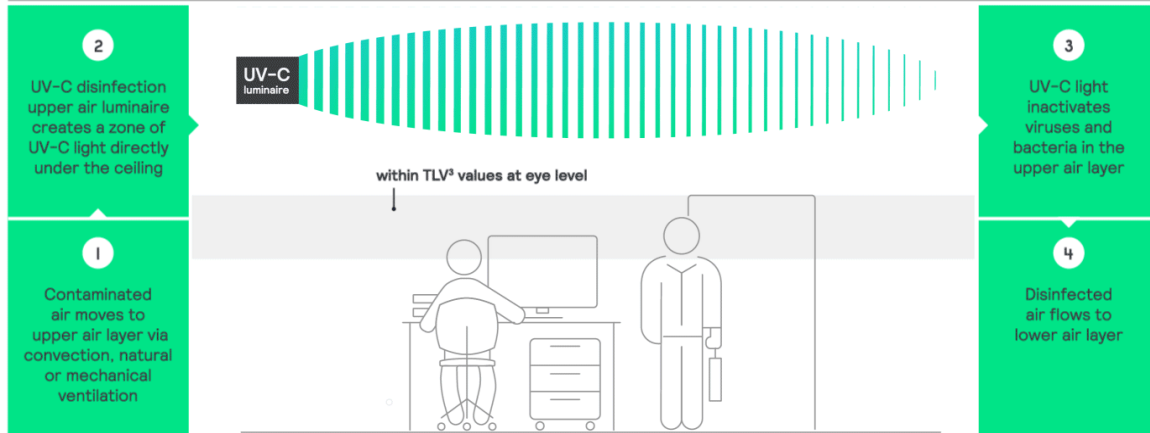
eACH~18-30



UV-C disinfection upper air continuously disinfects the air above us

UV-C disinfection upper air luminaires are effective against viruses and bacteria¹, cost-efficient to install, maintain and in energy usage², easy to implement and apply, and can be used with people present

People in the space can work while the UV-C system is on



Our Philips UV-C disinfection Upper Air wall mount luminaires inactivated 99.99% of SARS-COV-2, the virus responsible for the COVID-19 disease, in the air of a room within 10 minutes. At 20 minutes, the virus was below detectable levels

- **Enhanced Safety:** The beam of UV-C rays is controlled by specific reflectors and the louvre design. This allows for the disinfection of the air in a space when people are around.
- **Complies with All safety standards.**
- **Built To Last** AL Extrusion Housing for Light Weight, Solid Construction and no corrosion
- **Large area coverage:** Avg 20-28m² coverage with both Ceiling and Wall mounted units
- **Technology Recommended by CDC, KKM,NEA .**

Air moves with convection, passes through the UV- C zone and gets disinfected.

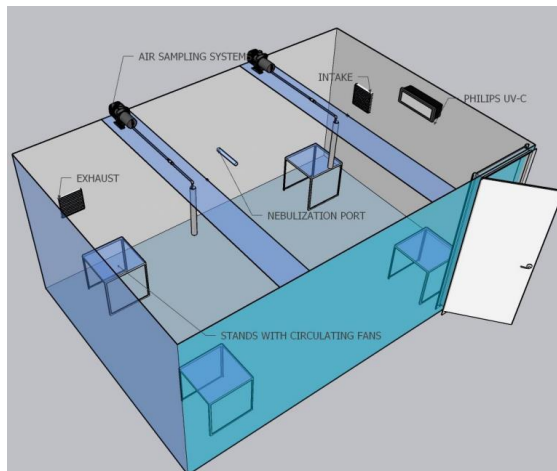
¹ Reed, N.G. 2010. The history of ultraviolet germicidal irradiation for air disinfection. Public Health Reports January-February, 125(1):15-27.

² Ko, G., H. Burge, E. Nardell, and K. Thompson. 2001. Estimation of tuberculosis risk and incidence under upper room ultraviolet germicidal irradiation in a waiting room in a hypothetical scenario.

³ Threshold Limit Value represents the maximum exposure for a period of eight hours as determined by the American Conference of Governmental Industrial Hygienists (ACGIH) Committee on Physical Agents

Signify upper-room UV-C technology achieved 50 eqACH in lab experiment

Signify's [upper-air UV-C airborne disinfection test](#) demonstrated that 99.99% (Log 4 reduction) of SARS-CoV-2 virus was inactivated in 10 minutes with a wall-mounted luminaire



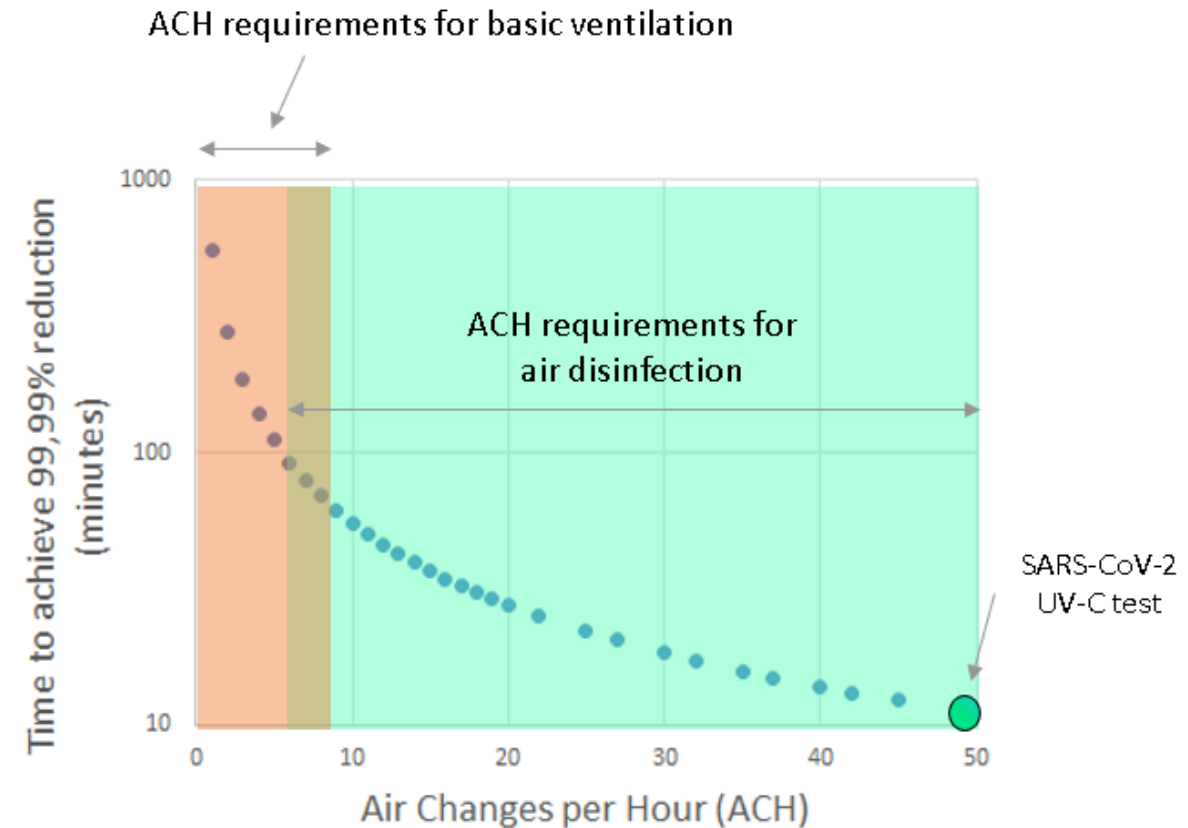
2,4 x 3,0 x 2,4m

This inactivation performance corresponds to

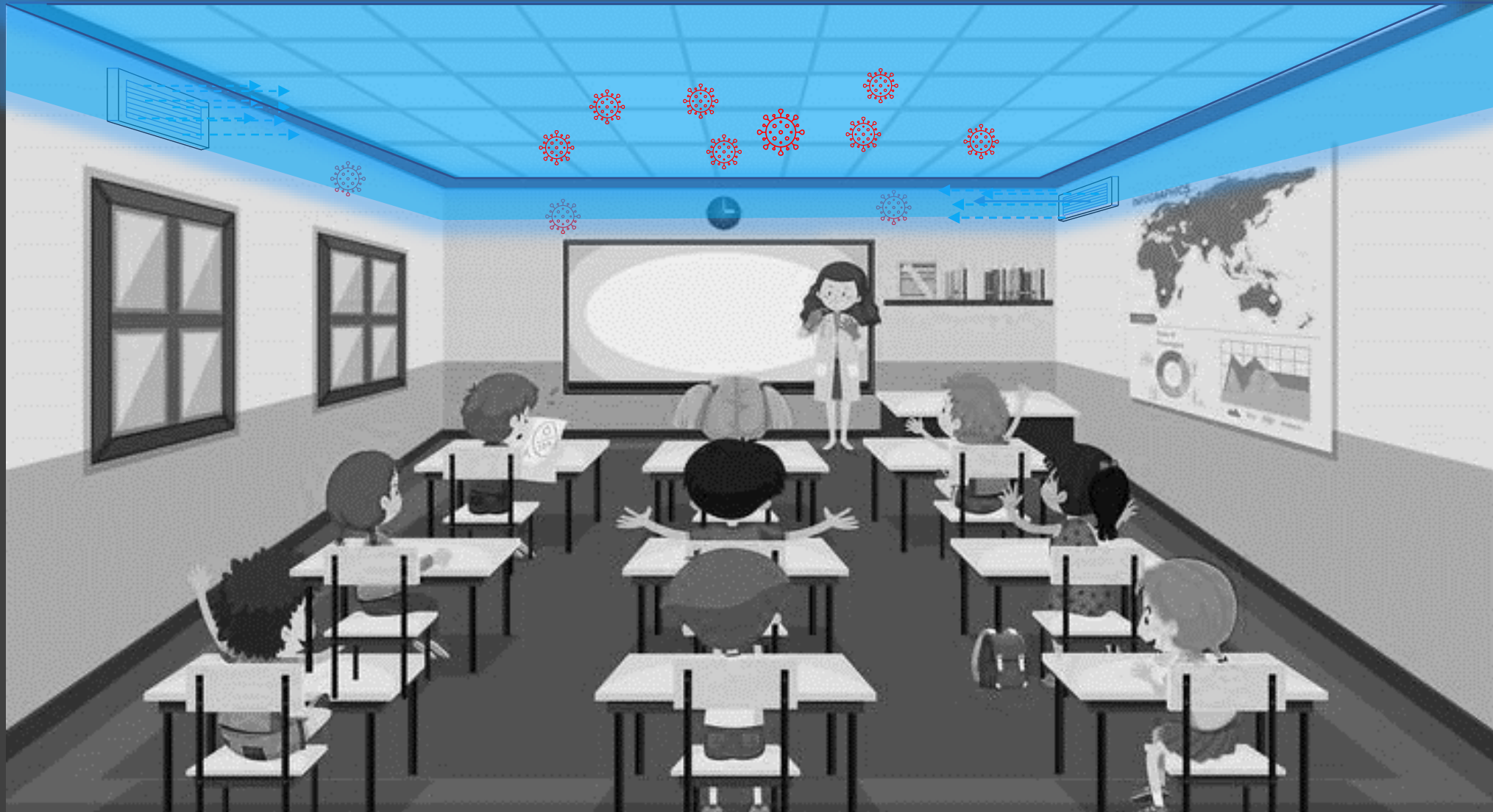
eqACH = 50 (for SARS-CoV-2)



3rd party test by Innovative Bioanalysis Labs



School Classroom Application





Offering 2: Philips UV-C Air Purifier

2 in 1 Purifies & Disinfects



Continuous Effective Disinfection with three different sizes that help in reducing the microbial count by >99.9%* !

- Completely Safe to use with no Ozone emissions / UVC leakage
- User Friendly touch panel for ease of operation with On/Off, timer, fan speed and lock settings and time display
- Indicator for lamp maintenance, lamp Lifeclass, Filter maintenance & Lifeclass
- Area coverage of up to 80 Sq. meter (for Bigger Size)
- Timer 1-16 hrs. at an interval of 1 hour
- Fan Speed Control 3 Steps
- Noise level < 34 db(A)
- Temperature Sensor
- Air quality index

eACH~1-20

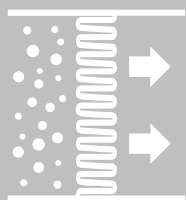


Multi layer filtration



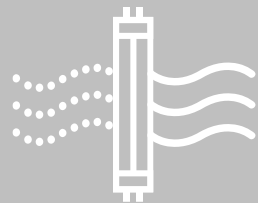
HEPA Filter

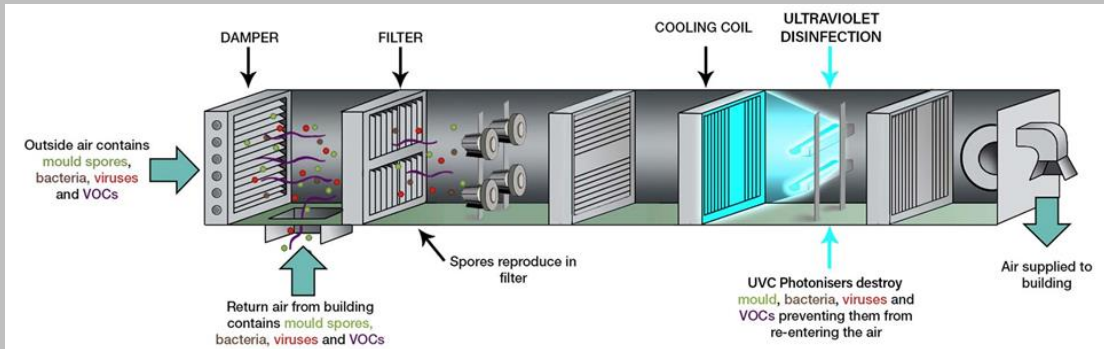
+



Carbon Filter

+





Sick Building Syndrome

- Damp and dark environment promotes rampant growth of Viruses, bacteria, mold, spores, fungus, etc. on cooling coil
- Pathogens get distributed across the buildings through the air-conditioning systems
- Makes Environment infectious, unhealthy and unsafe to breathe

Conventional Cleaning Methods Disadvantages

- Chemical cleaning and scrubbing damages coil reducing life
- Risk of chemical residue moving into the airstream
- Recurring ground water pollution

Higher Operational Cost

- 15-20% higher energy consumption ^[1]
- Increased fan consumption to compensate for increased pressure drop
- Reduced heat transfer efficiency due to thick bio-films

- **Effective Coil Cleaning**
- **Effective Air Disinfection Inside AHU**
- **Better Comfort**
- **Energy Savings**
- **Reduced Maintenance Costs, Less Downtime and Ground Water Pollution**
- **35 Years Of Experience And Leadership in UV Technology**
- **Best System Compatibility With In-House Lamp, Ballast and Controller**

Safety standards and certification programs for UV-C

Key international safety standards

- IEC 62471, the photobiological safety standard that describes exposure limits and risk groups for UV-C irradiance
 - Products categorized as risk-group products are not allowed, unless they contain additional protective measures that prevent too high human exposure
- ISO 15858:2016 specifies human safety requirements for the use of UV-C lamp devices
 - Applicable to in-duct and upper-air UV-C systems, portable in-room disinfection UV-C devices, etc.
- IEC 60335-2-65 specifies safety requirements for air-cleaning appliances

Early 2020 however, the lighting industry decided that more specific guidance needed to be given on how to make UV-C luminaires and systems safe

NORME
INTERNATIONALE
INTERNATIONAL
STANDARD

CEI
IEC
62471
CIE S 009:2002

In Belgium, through a recent governmental decree, for UV-C products addressing SARS-CoV-2, safety of UV-C installations is ensured by requiring compliance with:

- IEC 62471
- ISO 15858
- IEC 60335-2-65
- IEC PAS 63313



International
Electrotechnical
Commission



Professional services

The effectiveness and safe application of a UV-C solution starts with the right application design

Staff training & certification

Before your staff operate UV-C devices as part of new cleaning processes, we will provide safety training courses.

Lifecycle Services

- I. Our control systems can monitor and report on lamp burning hours or failures of fixed installations to provide proactive lamp maintenance to ensure effective use.
- II. Our service teams plan scheduled visits to provide and install replacement lamps safely and verify UV-C output so you can trust that solutions remain at optimal effectiveness.



BOSTON UNIVERSITY



National Institute of Allergy and Infectious Diseases

INNOVATIVE BIOANALYSIS



CENTER FOR GLOBAL HEALTH DELIVERY

HARVARD MEDICAL SCHOOL

intertek

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

TNO innovation for life

Fraunhofer

Signify continues to collaborate with renowned experts in the field

- Signify works with experts across the globe to investigate effectiveness of our products against SARS-CoV-2, and to conduct experiments and construct models that underpin our UV-C system design choices
- Signify collaborated with Boston University to perform a series of measurements to quantify UV-C inactivation rates of our products (i.e. dose-response curves)
- Innovative Bioanalysis Labs performed airborne SARS-CoV-2 tests using Signify upper room UV-C luminaires
- Further collaborations in the field of UV-C have been established with, e.g., TNO, the Netherlands Organization for applied scientific research and with several universities

Signify will also continue to contribute to UV-C related standardization activities across the globe, to share our latest quantitative insights on how to measure and express effectiveness



- The primary SARS-CoV-2 infection route is likely to be **airborne**
- Adequate **air disinfection**, based on ventilation and other means, is a key ingredient to mitigate risks, and **high (equivalent) air changes per hour are required**
- **UV-C is a proven technology** against pathogens, and in particular upper-air UV-C/ UV-C Air Purifiers are **highly effective, energy efficient and affordable**
- Adequate **international UV-C safety standards are in place**, and have been updated in the past year to enable broader use for UV-C as disinfectant
- **Safety** should always be in mind while using UV-C solutions

Contact us

Miftahul Jannah
Channel Marketing Manager
+60 12 307 6806 (mobile)
miftahul.jannah@signify.com
Signify Malaysia Sdn Bhd

OPTIMAX Eye Specialist in collaboration between Honeywell x Signify Malaysia

- OPTIMAX is a network of leading eye specialist clinics in Malaysia with more than 300,000 satisfied patients since 1995
- We installed a range of Philips products including UV-C disinfection upper air luminaires, and standalone UV-C disinfection trolleys. These solutions enhance well-being by disinfecting air and surfaces in rooms while being controlled and monitored by Honeywell's Healthy Buildings dashboard
- Honeywell and Signify offered our clinics a complete. Solution for air, surface and object disinfection that allows us to clearly communicate to our clinicians, staff and patients how we are working to support well-being in our spaces." -Tan Sri Dato' Tan Boon Hock, Founder, OPTIMAX Eye Specialist Centre



UV-C air disinfection in school buildings Amsterdam, Netherlands

- Schools face a major challenge in providing qualitative education in safe and engaging **classrooms** where new social health standards apply.
- By opting for UV-C disinfection lighting, schools go further than well-known measures, such as frequent ventilation, which often proves to be partially effective or economically unfeasible. Intervention in treating the air could be the best approach in keeping viruses as SARS-CoV-2 and seasonal flu away.
- Philips UV-C upper air disinfection lighting guarantees an almost complete, fast disinfection of the air in any room. By means of natural convection or mechanical ventilation, the air flows to the top layer in the room.
- Here the air encounters disinfecting UV-C light, after which it mixes again with air in lower parts of room.
- It offers students and staff extra protection in rooms with usually limited ventilation



Forte Partners Office Building Bucharest, Romania

- In the context of the COVID-19 pandemic, Forte Partners had to quickly adapt, hence they have been seeking for the most efficient procedures and safety measures, in order to give their tenants, the comfort to return to the office.
- As an innovative developer, Forte Partners needed a revolutionary, efficient solution
- Therefore, they were the first partner to adopt the UV-C solution in their HQ office by installing Philips UV-C Upper Air disinfection luminaires in the **office space and meeting rooms**.
- Forte Partners became pioneer in UV-C air disinfection, moving forward introducing it to their tenants, in order to prove them it is possible to create a safe environment for people to stay and work in.



't Klaslokaal Bloemendaal, the Netherlands

- 't Klaslokaal is a gym school based in Bloemendaal, the Netherlands.
- Despite all the efforts and adjustments, including aerobics lessons via Zoom and lessons in the parking lot, the business was suffering. He had to close his exclusive women's gym and adapt.
- Being an entrepreneur, Timmers reinvented himself and developed a new concept: a disinfected gym, where one can easily exercise at a 1.5 m distance, without worrying about being too close to others in an indoor space where the virus can spread.
- Next to excellent ventilation he installed Philips UV-C disinfection upper air units in his gym, which are designed to be installed on ceilings for the disinfection of air in the upper areas of a room in a wide range of applications.



PSV Eindhoven

Eindhoven, The Netherlands

- A virus-free environment is high on agenda of clubs and associations like Premier league team PSV Eindhoven. That's why PSV chose Philips UV-C upper air disinfection lighting for **various rooms**.
- PSV installed Philips UV-C disinfecting upper air luminaires at both locations. In stadium, UV-C units were installed in home **team changing room** and in the **visiting team changing room**. At campus, there are UV-C units in **changing rooms** and in **medical room**. These are areas where players spend relatively long time with each other in proximity, and where the risk of contamination is high.

"The health of our players is extremely important to us, and actually essential for the progress of matches. With Philips UV-C disinfecting upper air luminaires, we can offer our players and those of visiting clubs a little more protection."

-Frans Janssen, PSV Commercial Director



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.



Signify