

## General FAQs

### What is UV?

Ultraviolet (UV-C) – refers to short-wavelength ultraviolet radiant energy that has been shown to kill bacteria and to inactivate viruses. Wavelengths in the ultraviolet band known as the “UV-C” (from 200 to 280nm), have been shown to be the most effective for disinfection.

### Is UV-C new technology?

No. UV-C has been used for decades to clean air, water, and surfaces. Signify has over 40 years of experience providing UV-C sources for use in a wide range of disinfection applications.

### How does UV-C work to inactivate a virus?

On a microscopic level, individual, UV-C photons interact with the RNA and DNA molecules in viruses and bacteria to render them non-infectious.

### In lighting we have lumens as measurement, how is UV-C effectiveness measured?

UV-C effectiveness is proportional to the exposure dose (radiant exposure, typically in millijoules\* per square centimeter, mJ/cm<sup>2</sup>, or joules per square meter, J/m<sup>2</sup>), which is the product of the radiant power (irradiance, typically in mW/cm<sup>2</sup> or W/m<sup>2</sup>) and time (from 1 μs to several hours).

### How much dosing is required for eliminating a pathogen?

UV-C effectiveness is usually measured on a log-scale, which is linearly associated with dose. For instance, if 1 mJ/cm<sup>2</sup> UVGI (Ultraviolet germicidal Irradiance) achieves a 1-log (10-fold) killing rate, then 4 mJ/cm<sup>2</sup> would achieve a 4-log (10,000-fold) killing rate. The 4-log rate is commonly referred to as 99.99%.

If a certain UV exposure kills 90% of a bacterial population (frequently referred to as “one-log kill”), doubling the exposure time or intensity can kill only 90% of the residual 10%, for an overall germicidal efficacy of 99% (“two-log kill”). To be effective in practice, achieving two log-kills (99% inactivation) is frequently accepted.

### How do we know it works and in particular for viruses?

All known micro-organism is susceptible to UV-C. Bacteria, mold and fungi will be killed, and viruses will be inactivated. It is only a matter of how much time and how much radiant power is provided.

*(Source: 1 Fluence (UV Dose) Required to Achieve Incremental Log Inactivation of Bacteria, Protozoa, Viruses and Algae Revised, updated and expanded by Adel Haji)*

The dose required to achieve 1-log killing is often called the D90-value (where 90% of the pathogen is killed), and these values have been empirically determined for many pathogens and microorganisms.

*(Source: Kowalski -2017)*

UV-C has been demonstrated to work very effectively to inactivate viruses including coronaviruses.

*(Source: Darnell et al. – 2004 showed that UVC exposure resulted in >5 log reduction of SARS-CoV.)*

### Will UV-C work on the SARS-CoV-2 (COVID-19)?

The National Emerging Infectious Diseases Lab at Boston University conducted research to confirm the effectiveness of Signify’s UV-C sources in inactivating SARS-CoV-2, the virus that causes Covid-19. The research team identified that a dose of 22mJ/cm<sup>2</sup> will result in a reduction of 99.99% of SARS-CoV-2.

*(Source: [Signify Press Release](#))*

### Is UV-C the same as “Near UV” solutions currently being sold?

No. UV-C is electromagnetic wavelengths, while Near-UV is 405nm wavelength visible light.

While UV-C has proven to be highly effective at inactivating viruses and other pathogens, Near-UV has limited effectiveness against viruses, and requires long exposure times to be effective on surface bacteria.

## **Are UV-C cleaning solutions safe?**

UV-C poses a health hazard to the eyes and skin if the lamps are improperly used or installed.

We have developed a UL8802 Safety Certified UV-C System designed to meet new UL 1598 standards.

## **If these are not “light” then how do you know it is on?**

Like odor added to natural gas, the UV-C source does have some emission that is visible so that you can see when it is on. These products are blue when on.

## **Does surface UV-C solutions replace the need for cleaning?**

No. While UVGI has been shown to be excellent for cleaning surfaces, it does not penetrate surfaces and cannot clean dirty surfaces. The inability of the UV radiant energy to reach shadowed recesses of surfaces or to penetrate dust and other matter may negatively affect cleaning. For these reasons, UV-C is typically used as a supplement to other cleaning processes. “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”.

(Source: [fda.gov](https://www.fda.gov))

## **Can surface UV-C technology solutions be used to clean PPE?**

The cleaning of PPE should be conducted with FDA approved processes and technology. Currently, there is no FDA approval for use of these products for use in cleaning PPE. We recommend following manufacturer and FDA guidelines for the cleaning of PPE.

## **I have heard these need to be EPA approved, what does that mean?**

UV-C devices are officially listed as pesticide devices. As such, pesticides production facilities must be registered with the EPA. All our production facilities are registered and comply with these regulations.

## **What technology is used for UV-C?**

There are both low-pressure discharge “pin-based” and LED solutions available.

The LED solutions, however, are limited, and the efficiency is orders of magnitude lower than UV-C.

The Cooper Lighting Solutions will use bi-pin sources and specialized materials to maximize the power distribution of the UV-C. While they look like lamps, they do not produce visible light, so they are considered to be emitters.

## **How does this light affect artifacts in a room?**

Prolonged exposure to UV-C will degrade paint, yellow plastics, and dull the surface finish of shiny objects.

## **How do we determine the number of sources and energy required to effectively clean an area?**

Similar to light energy, we have tested IES files that provide the irradiance and the electrical power needed to operate each fixture.

Similar to lighting layouts, we can translate this into power delivered to an area in the same manner we calculate foot candles.

The power can be translated to the time needed to eliminate a pathogen based on its “dose”. This time is typically planned for elimination of 99.99% from the surfaces. In many cases the “4-log kill” is accomplished in minutes.

## **What UV-C Surface technology fixture types can we consider for opportunities?**

Cooper Lighting Solutions has released several fixtures in our Fail-Safe product line utilizing UV-C technology, including a highbay, troffer, louvered parabolic, undercabinet, and strip. Click here to learn more about these products.

## **Do the Cooper Lighting Solutions UV-C Upper Air fixtures move air in the space where installed?**

No, they do not. They take advantage of the natural air flow in the room due to convection, people moving in the space, as well as the HVAC system.

## **IES Committee Report**

Germicidal Ultraviolet (GUV) – Frequently Asked Questions

Air Change per Hour (ACH) is a measure of how many times the air within a defined space is replaced. Indoor Air Quality (IAQ) can directly improve by increasing the ACH with an HVAC system. Most commercial applications deliver 3-4 ACH. Recommendations from CDC are to deliver 6–10 ACH for optimal IAQ. With an HVAC system, 6 ACH is considered uncomfortable and above 10 is loud and windy. Our fixtures disinfect the air and increase the effective ACH (eACH) in a space without increasing the air flow in the room. Using these products, the eACH can reach up to 18, which has demonstrated 80% reduction in the spread of tuberculosis.

[1] *Mphahlele.M. et al (2015) Institutional Tuberculosis Transmission: Controlled trial of upper room ultraviolet air disinfection – A basis for new dosing guideline.*

[2] Interpolated data.

[3] Adapted from CDC (1994). Guidelines for preventing the transmission of Mycobacterium tuberculosis in health care facilities. MMWR 1994; 43 (RR- 13): 1-32.

### **Are UV-C Upper Air solutions safe?**

Exposure to UV-C can cause temporary skin irritation (think sunburn) or eye irritation (think welder's eye or mild eye sunburn). Our UV-C Upper Air products are optically designed to control the UV-C irradiance and ensure it remains in the space above the occupants. UL 1598 annex L requires the installation to confirm.

### **Can people be in the room when the UV-C Upper Air products are on?**

Absolutely. These products are designed for continuous use in an occupied space.

### **How do UV-C Upper Air fixtures compare to surface fixtures?**

Upper Air fixtures are designed to clean air while surface fixtures are designed to clean surfaces. Upper Air fixtures don't require controls and can be on while the space is occupied, while surface fixtures can only be in use if the room is vacant. Using these products together greatly increases cleaning efficiency.

### **Are Upper Air fixtures UL listed?**

Yes, they comply with the UL 1598 standard and the new annex L requirements for UV-C products.

### **How do I know how many UV-C Upper Air fixtures are required?**

Roughly speaking, a ceiling unit will cover approximately 120 square feet. To ensure irradiance requirements, the fixtures should be located at least 6 feet from the wall and can be spaced at least 12 feet apart. The wall units will cover approximately 160 square feet. These can be spaced 8 feet apart and can be installed as low as 8'3" from the floor. These are general guidelines and actual applications are influenced by the reflectivity of the ceiling and walls as well as the geometry of the room.

### **Can I get a more exact layout using UV-C Upper Air fixtures?**

Absolutely. If requested, Cooper Lighting Solutions will create a design for you based on the dimensions of the room and the desired cleaning time. We can design the fixture layout to ensure the fluence rate delivers the effective air changes per hour (eACH) desired and remain below the irradiance limits for the occupied portion of the room.

### **Can we buy the UV-C sources directly?**

No. We are building a complete system that combines expertise in materials, optics, UV-C sources and biology to develop complete solutions.

### **Where can we find more information?**

We have a microsite developed and will be adding new content often. ([cooperlighting.com/guv](https://cooperlighting.com/guv))

**Citation**

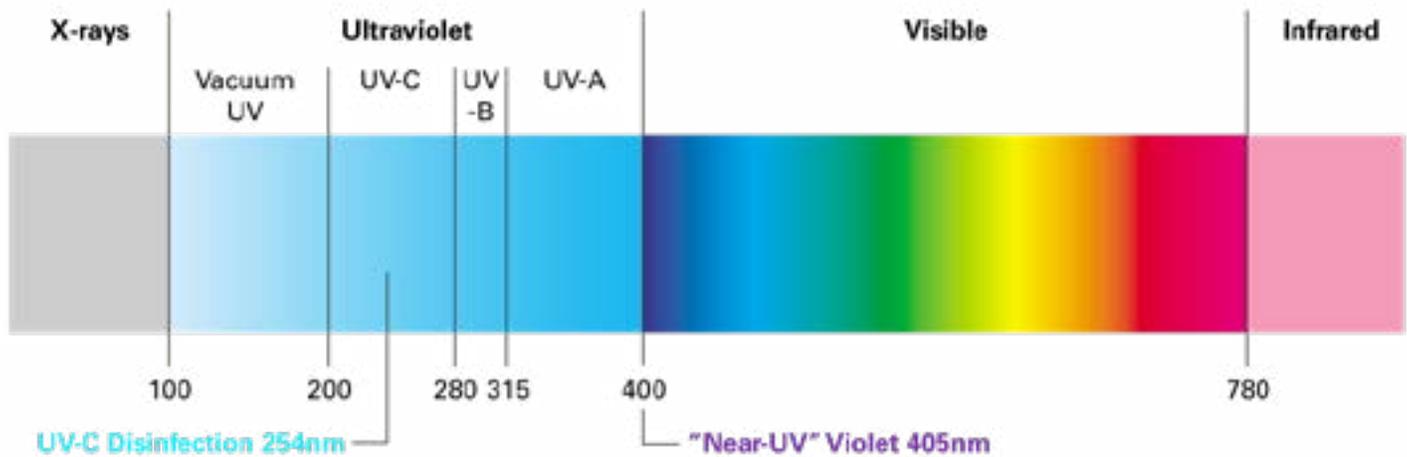
Darnell, Miriam E.r., et al. "Inactivation of the Coronavirus That Induces Severe Acute Respiratory Syndrome, SARS-CoV." Journal of Virological Methods, vol. 121, no. 1, 2004, pp. 85–91., doi:10.1016/j.jviromet.2004.06.006.

**IES Committee Report****Germicidal Ultraviolet (GUV) – Frequently Asked Questions.**

The report was prepared by the IES Photobiology Committee with the goal of providing objective and current information on germicidal ultraviolet irradiation as a means of disinfecting air and surfaces. IES does not endorse or recommend any products. [Read More.](#)

**UV-C Technology****What is disinfecting Lighting?**

Disinfection Lighting is lighting that operates at specified wavelengths to inactivate harmful pathogens and viruses.

**Far UV****Unknown Pathogen Effects / Exposure Risk / Technology Infancy**

Ultraviolet (UV) (not Lighting) emission band in specific wavelengths that has been shown to inactivate viruses and kill bacteria, mold, and fungi with relatively short exposure duration.

- 222nm, Non-visible
- Technology infancy
- Unclear pathogen effects
  - Virus effect being tested
  - Effective on bacteria
  - Not effective on mold or fungi
- Exposure time tested
- Exposure risks
- Ozone risks

**Germicidal UV (UV-C)****Superior Pathogen Effect / Controllable Exposure Risks / Proven Technology**

Ultraviolet (UV) (not Lighting) emission band in specific wavelengths that has been shown to inactivate viruses and kill bacteria, mold, and fungi with relatively short exposure duration.

- 254nm, Non-visible
- Proven technology (no known micro organisms resistant to UV-C) \*
- Proven pathogen effects
  - Inactivates viruses
  - Kills bacteria
  - Kills mold and fungi
- Exposure time is short
- Exposure risks

\* *Fluence (UV Dose) Required to Achieve Incremental Log Inactivation of Bacteria, Protozoa, Viruses and Algae Revised, updated and expanded by Adel Haji Malayeri, MadjidMohseni, 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.*

**UVA/B****Limited Pathogen Effect / Controllable Exposure Risks / Proven Technology**

Ultraviolet (UV) non-visible emission in the UV-A and UV-B wavelength bands that provide a germicidal effect over extended exposure periods.

- 315/365nm Non-visible
- Proven technology
- Limited pathogen effect
  - Low virus inactivation
  - Reduces bacteria
  - Limited effect on mold, fungi
- Exposure time is moderate
- Exposure risk

**Near-UV****Limited Pathogen Effect / Limited Exposure Risks / Technology Infancy**

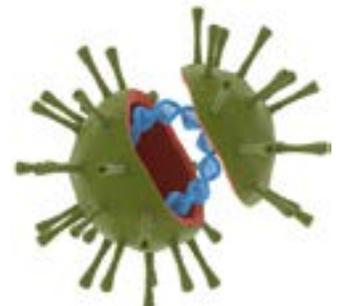
Lighting that operates outside of the UV spectrum at wavelengths shown to kill bacteria with long exposure durations.

- 405nm, Visible light
- Technology infancy
- Limited pathogen effect
  - Extremely limited viruses effect
  - Reduces bacteria
  - Unknown effect on mold and fungi
- Exposure time is long
- Limited exposure risks

**How does UV-C work?**

Complex Science. Simple Answer.

- RNA / DNA of a microbe can be altered
- A virus is not a living organism – it cannot be killed. It can be inactivated
- UV-C wavelengths (254nm) have high energy that alter RNA / DNA in microbes
- This energy destroys the nucleic acids altering the structure of RNA and inactivates the virus



### Are there safety concerns?

Complex Science. Simple Answer.

- Intended for operation while spaces are not occupied
- UV-C technology is harmful to eyes and skin

### Safeguards

- Operate only with proper personal protection equipment (PPE)
- On/Off UV-C source is visible – blue hue during operation
- UV-C technology has limited penetration (walls, glass>3mm)
- The best safeguards are through proper application design

