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# Is UVC Safe?

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Deep ultraviolet (UVC) light emitting diodes (LEDs) are an irradiation source and require due precautions to ensure safe usage. This page contains information intended to familiarize users with the current understanding of some of the general practices and precautions most often recommended in the literature for UV irradiation sources (further information is provided in this [application note](#)). It is not meant as an exhaustive review on the topic. Currently, there are no work place related rules and regulations that are set by OSHA (Occupational Safety and Health Association) in regard to UVC environmental health and safety.

# UV Light and Health Effects

The UV range of the electromagnetic radiation spectrum extends from 10 nm to 400 nm. Depending on the wavelength and time of exposure, UV radiation may cause harm to the eyes and skin.

The UV spectrum is separated into four parts: UVA (315 nm to 400 nm), UVB (280 nm to 315 nm), UVC (200 nm to 280 nm) and UV Vacuum (100 nm to 200 nm). Decreasing wavelengths correspond with higher frequency radiation and a higher amount of energy per photon.

[Learn more about UVC and how it works for disinfection](#)

## Biological Effect of UV Light

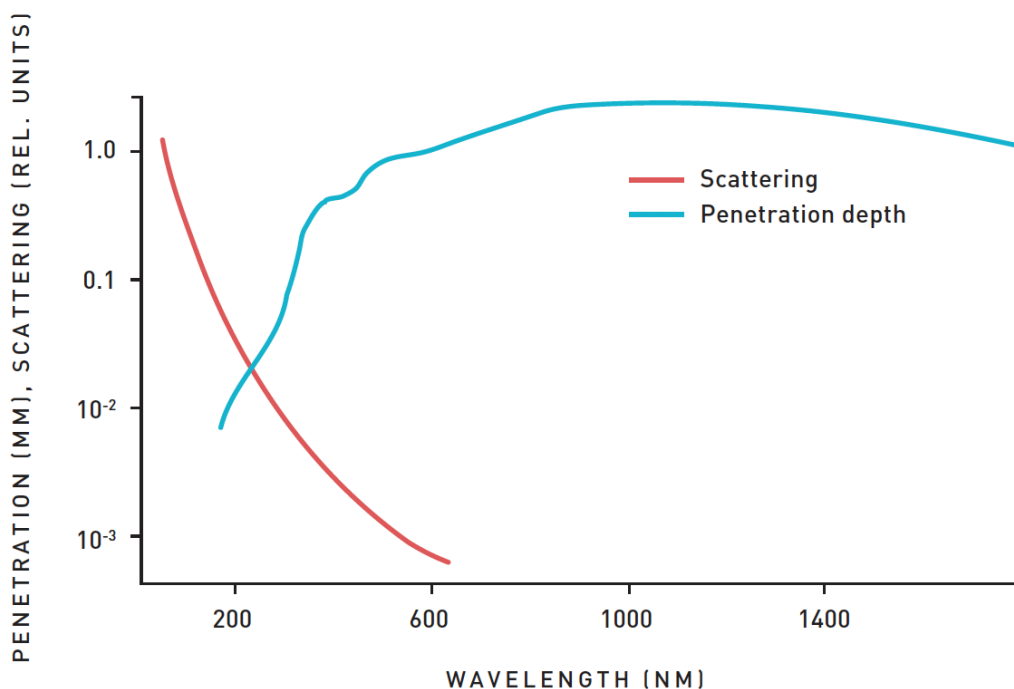
While UVB radiation is widely recognized for its harmful effects on human skin and links to skin cancer, each of the UV bands (UVA, UVB and UVC) create different risks for humans.

UVC radiation refers to wavelengths shorter than 280 nm. These wavelengths are entirely absorbed by our atmosphere and no natural UVC radiation reaches the surface of the earth. These wavelengths are available to us through artificial sources, such as UVC LEDs or mercury lamps. The intensity from point sources like UVC LEDs falls off as 1 over distance squared, and once it gets past the scattering length, it falls off exponentially. This means that 1) the further away the UVC source from a human, the lesser dose he is exposed to, and 2) the absorption length of UVC radiation in human skin is extremely short so that almost no UVC radiation can reach the living cells in the skin; all the absorption occurs in the dead cell layers.

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### FIGURE 1 :: IMPACT OF UV LIGHT ON HUMAN TISSUE

The penetration spectrum of light and UV radiation into human tissue.  
The scattering increases with decreased wavelength.



In rare instances of prolonged direct exposure to UVC light, temporary eye and skin damage has been exhibited, such as cornea injury (sometimes referred to as “welder’s eye”) although this generally heals after a couple of days. Therefore, safety recommendations with UVC LEDs include protecting skin (in particular open wounds) and, most importantly, the eyes from UVC radiation. The EU health agency’s safety guidelines on the use of UVC sources can be found [here](#). In particular, the study concludes:

“In any case, UVC is strongly attenuated by chromophores in the upper epidermis (Young, 1997) and UVC-induced DNA damage in the dividing basal layer of human epidermis is not readily detected (Campbell et al, 1993; Chadwick et al, 1995) which may explain why the dose response curve for UVC erythema in human skin is very much less steep than for UVB (Diffey and Farr, 1991). It is unlikely that UVC from artificial sources presents an acute or long-term hazard to human skin. However, UVC is likely to cause acute photokeratitis... UVC exposure is unlikely to cause acute or long-term damage to the skin but can cause severe acute damage to the eye and should not be permitted at all from any tanning device.”

The same study found the minimum health and safety requirements regarding the exposure of workers to risks arising from artificial optical radiation (2006/25/EC) - albeit for all UV bands combined: “Exposure limit value for UV (180-400nm) is 30 J/m<sup>2</sup> (= daily value of 8h)”

## UVC Effect on Skin

Acute (short-term) effects include redness or ulceration of the skin. At high levels of exposure, these burns can be serious. For chronic (long-term) exposures, there is also a cumulative risk, which depends on the amount of exposure during your lifetime. The long-term risk for large cumulative exposure includes premature aging of the skin and skin cancer.

## Personal Protective Equipment (PPE)

UV radiation is easily absorbed by clothing, plastic or glass. Once absorbed, UV radiation is no longer active. When working with open UV radiation during maintenance, service or other situations, personal protective equipment covering all exposed areas is recommended. When working around UVC devices, one should:

- Use UV goggles and/or full-face shields.
  - Prescription glasses and normal safety glasses do not protect eyes from UV exposure, so ANSI Z87 rated eyeglasses with wrap around lens to protect the side exposure is recommended. Consult with ANSI Z87 manufacturers for proper UV exposure protection equipment.
- Cover any exposed skin using lab coats, nitrile gloves or other lab attire.

## Safety Design/Control/Monitoring/Maintenance

UVC exposure can be reduced through product safety design considerations and controls. For example, safety switches wired in series allow UVC sources to be turned off without exposing workers to UV light. Or placing ON/OFF switches for UVC light sources separate from general room lighting in locations only accessible by authorized persons. Switch locations should be locked or password protected to ensure that the UVC source is not accidentally turned on. Each UVC system should have the option of a viewport so workers can view the lamp assembly without the possibility of over-exposure to UVC.

Proper installation, monitoring, education of maintenance personnel, signage and use of safety switches can help to avoid overexposure. The operating instructions and recommendations for proper use of any UV system should be kept for reference to reduce hazardous exposure. These should be clearly visible for the operators or maintenance personnel and include the temperature and relative humidity ranges specified by the system design to ensure safe operation. Maintenance should be performed according to manufacturer's instructions

electric power should always be turned off to prevent accidental exposure. There are no standard guidelines for monitoring UV equipment, but there are commercial UV monitors that detect output or leakage.

## **Response to UV Exposure**

The effects of acute exposure to UV radiation are usually not severe and many symptoms are delayed. In the event of UV exposure, the following actions are recommended.

- See an ophthalmologist if eye damage is suspected.
- Treat skin lesions immediately.
- Follow your organization's EHS incident reporting procedure. These often require documentation of the date and time of the incident, persons involved, equipment involved and type of injury.

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