

Guidance for the Safe Use of UVC Radiation for Surface and Air Disinfection in MIT Spaces

October 6, 2020



Overview:

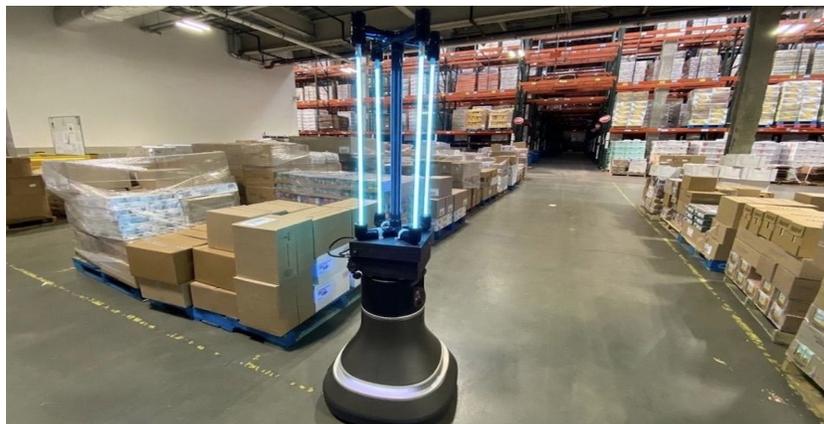
In the midst of a global SARS-CoV-2 pandemic one strategy being used to reduce virus surface and air contamination is disinfection with germicidal UVC ultraviolet radiation.

The use of UVC Ultraviolet radiation has been proven to be effective against a number of viruses and other pathogens, however as UVC is capable of inactivating these viruses, so to can it cause individual harm if not properly controlled. It is important that all uses of UVC that might result in human exposure be evaluated for personnel safety.

Safety Recommendations:

The use of UVC germicidal disinfection systems can be done safely by implementing the following safety procedures as appropriate:

1. Restricting access to areas in the process of being disinfected.
2. Posting warning signs at entrances to areas being disinfected.
3. Performing UV exposure measurements to determine “safe” areas.
4. Scheduling disinfection process and communicating these schedules to potentially affected parties (area occupants, custodians, Facilities, EHS)
5. Registering the UVC devices and process locations with the EHS Radiation Protection Program (RPP) to allow for a risk assessment and UVC measurements as necessary.



In tests, the CSAIL team's robot could disinfect a 4,000-square-foot space in the food bank's warehouse in just half an hour.

Credits: Photo: Alyssa Pierson/CSAIL

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6. *For fixed UV units in HVAC systems, in ceiling spaces and other areas use interlocks on air handler doors where there are UV lights and warning signage to shut the*
7. *lights off on ceiling units before workers get on a ladder to work on the units or to work adjacent to the units.*
8. *Proper PPE for skin and eyes must be available as there are times people do need to work on or measure systems that are on.*
9. *UV light can only sanitize surfaces it can reach, basically it won't clean behind an item in front of it.*
10. *Follow the maintenance recommended by the manufacturer to maintain the efficacy. If dust settles on the lamps, it would affect it's ability to sanitize.*
11. *Appropriate training must be provided for those who operate, maintain or occupy spaces where such devices might be used.*

Note: UVC is not readily distinguished from visible light when both UV and normal lights are on. Many instances of photo keratitis have been reported when workers repaired a device with UV and regular lights, not realizing the UV lights were on.

Health Effects:

All wavelengths of ultraviolet radiation are considered Class 1 Known Human Carcinogens as rated by the International Agency for Research on Cancer of the World Health Organization. (IARC, 2006) In addition, the US National Toxicology Program rates all UV wavelengths (UVA, UVB, and UVC) as “Known carcinogens to humans”. (NTP, 2002) The 254 nm mercury vapor emission line within the UV spectrum has historically been the most widely used germicidal wavelength. At the power levels of UVC that can effectively kill germs in the air or on surfaces, safe durations of exposure to humans is typically limited to a few minutes per day. Excessive UV radiation absorbed in the outer layer of the eye, the cornea or conjunctiva can lead to pain, inflammation, and photokeratitis (“welder flash”).

Table 1. Maximum exposure times allowed for various effective irradiances at the 254 nm wavelength

Maximum Exposure Time (hours)	Irradiance ($\mu\text{W}/\text{cm}^2$) at 254 nm
8	0.2
4	0.4
2	0.8

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1	1.7
1/2	3.3
1/4	6.7
1/60 (1 minute)	100

An occupational exposure to a power level of just 0.1 mW/cm²* leads to a very short allowable worker exposure time of one minute. The ACGIH TLVs represent conditions under which nearly all healthy workers may be repeatedly exposed without acute adverse health effects of erythema and photokeratitis.

References:

- [International Commission on Illumination \(CIE\) Position Statement on the Use of Ultraviolet \(UV\) Radiation to Manage the Risk of COVID-19 Transmission](#)
- [CIE 187:2010 UV-C Photocarcinogenesis Risks from Germicidal Lamps](#)
- [CIE 155:2003 Ultraviolet Air Disinfection](#)
- [International Commission on Non-Ionizing Radiation Protection \(ICNIRP\) Ultraviolet](#)
- [American Industrial Hygiene Association \(AIHA\) COVID-19 Pandemic Efforts - Free Public Resources](#)
- [AIHA Occupational Safety and Health Guide for Surface Disinfection Practices using Germicidal Ultraviolet Radiation](#)
- [U.S. Food & Drug Administration \(FDA\) UV Lights and Lamps: Ultraviolet-C Radiation, Disinfection, and Coronavirus](#)
- [ICNIRP: UVC LAMPS and SARS-COV-2](#)