

About UV (UVC) Safety

This article provides some of the guidelines that employers, employees, and individuals can follow to protect themselves and their workplace against overexposure to UVC.

DR.ABDULAZIZ ALSUBKI

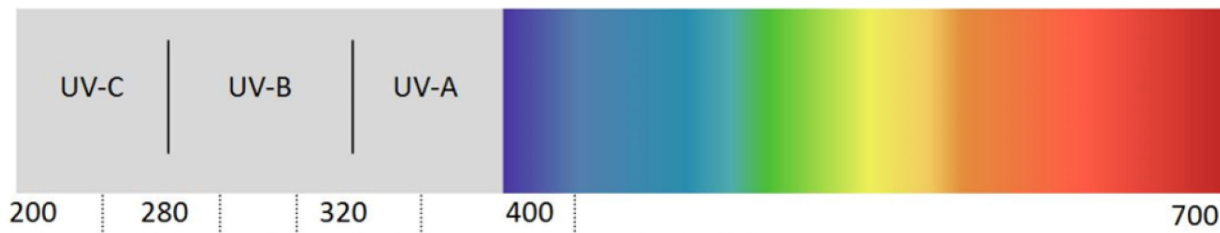
31 MAY 2020 • 5 MIN READ



UV (ultraviolet) light is invisible light energy just outside of the range of visible light that travels in waves. UV is all around us because it is made by the sun. But it is also used in many industrial applications like germicidal lamps for disinfecting surfaces, air, and even water, blacklight inspection for quality control and law enforcement, and even curing certain industrial materials.

UV light is classified into different categories based on its wavelength. There are three main types of UV:

- UVA (315 nm – 400 nm)
- UVB (280 nm – 315 nm)
- UVC (100 nm – 280 nm)



UVC is the highest-energy form of UV radiation and is the type used for disinfection. A wavelength of 253.7nm is most often emitted by low-pressure germicidal lamps. This article discusses some of the safety concerns of UVC radiation and ways that employers and individuals can mitigate these concerns through both engineering controls (about the system as a whole) and administrative controls (providing guidance and equipment to individuals using the system).

Health Effects of UVC Light

UVC light from the sun is absorbed by the atmosphere, so the risk of UVC exposure from going outside is minimal. Most UVC exposure occurs from germicidal UVC disinfection systems. Of the three types of UV light, UVC is the most damaging to living tissues because it has the highest energy.

However, it also does not easily penetrate the skin, so most damage from UVC radiation occurs on the surface of the skin or in the eyes, which are much more sensitive than the rest of the skin.

The health effects from UVC can be either acute (short-term) or chronic (long-term). Acute effects of UVC exposure include:

- Redness or irritation of the skin
- Erythema (sunburn)
- Eye injuries or irritation

Chronic effects of cumulative UVC exposure include:

- Premature aging of the skin
- Skin cancer

Because UVC has the most potential for acute health effects of the three forms of UV light, it's important that employers and individuals are aware of these risks and take adequate steps to ensure safety. UVC safety is a multifaceted strategy and involves both preventing exposure through engineering controls and through administrative controls.

Engineering Control Measures for UVC Safety

Engineering control measures for UVC safety are designed to minimize the general exposure to UVC radiation by optimizing UVC systems for the space they are in and the purpose they serve. Here are some of the engineering controls to consider for UVC safety.

Location

When possible (for example, for biosafety cabinets), UVC systems should be kept in a separate space from where people work. When this is not possible (like in a system designed to disinfect the air in a working laboratory), the switches should be wired in series or placed in a separate room only accessible to authorized individuals. This can ensure that the system is only running when employees are safe from exposure.

Interlocks

Systems for sanitizing equipment like biosafety cabinets should have some sort of interlock system to stop them from emitting UVC when open. This is sometimes built into a system, but some manufacturers also produce retrofit kits to add an interlock system to a biosafety cabinet.

Viewports

A viewport allows a worker to see the UVC lamp without exposing themselves to UVC light. This is important for general protection and awareness in the workplace as well as for maintenance and repairs to the system.

UV Filters

UV filters should be considered when deciding on the layout of a workplace using a UVC system. Well-positioned filters can provide an extra layer of protection when preventing exposure entirely is not possible.

Emergency Stops

All UVC systems should be equipped with an emergency stop to prevent excess exposure in the case of an accident or catastrophic failure.

Managing Reflected Light

UVC systems are often installed in places with other equipment around, which are often made of reflective metal or other materials. Reflected UVC

light is also hazardous, so these reflective surfaces should be painted with a non-UVC-reflective paint. This is generally not a specialized product – most common paints absorb UVC light, especially darker colors.

Exposure Limit Values

The International Commission on Non-Ionising Radiation Protection (ICNIRP) have established safe limits for UVC exposure (exposure limit values). These values are based on the level of UV light exposure below which individuals can be repeatedly exposed without adverse health effects. These limits should be accounted for in manufacturer's guidelines for using UVC systems and be indicated in the instructions, including a maximum exposure time per eight-hour workday.

If this data is not available, measurements and assessment will have to be made to establish these values for a given system. This will require the assistance of a specialist with the appropriate tools and knowledge.

Administrative Controls for UVC Safety

Administrative controls for UVC safety ensure that employees are protected on an individual level and aware of their role in ensuring safety. Here are some of the factors that should be considered.

Optimizing Workflow to Minimize Exposure to UVC

Access to the UVC system should be limited to those personally involved in its use. Additionally, UVC use should be scheduled in such a way as to minimize the number of people in the area when the system is active.

Personal Protective Equipment (PPE)

Employees need to be provided with and trained in the use of personal protective equipment (PPE) for UVC exposure. Because so many materials absorb UVC, most uses (except for face and eye coverings) do not require specialized PPE, but this PPE needs to be worn whenever there is a risk of UVC exposure (even if the task at hand might not otherwise warrant so many layers of protection). Some of the forms of PPE for UVC exposure include:

- **Goggles:** Ensure that the model of goggles worn are approved for protection from UVC and also provide wraparound protection.

- **Face shields:** Face shields provide better protection than goggles alone, which may protect the eyes but not the skin on the rest of the face. When possible, wear a face shield in conjunction with goggles.
- **Gloves:** Nitrile gloves protect well against UVC, especially when thick gloves are used, or thin gloves are used in a double layer.
- **Lab coats:** Most clothing in general absorbs UVC light, but employees should wear lab coats as an additional layer of protection, as well as for general protection against other hazards involved in the task at hand.

Training

Anybody operating or working near the system needs to be aware of its operation and the individual rules and regulations in place for that system. This should include points such as:

- A list of individuals who are authorized to use the system
- What times the system is activated
- Proper use of personal protective equipment
- Acute and chronic symptoms of UVC exposure
- Understanding of all warning signs and labels on the UVC system
- Understanding all procedures in place for using the UVC system, including what happens in the event of a malfunction.

Training should be renewed at regular intervals depending on need and staffing.

Conclusion

UVC is one of the most effective ways of disinfecting surfaces and equipment. It uses no harsh chemicals, leaves no residue, and it is extremely effective when used correctly. However, the significant health risks of UVC mean that this technology must be used wisely and safely.

This article provides some of the guidelines that employers, employees, and individuals can follow to protect themselves and their workplace against overexposure to UVC. But the most important step is to remain aware of where UVC exposure occurs in the workplace, as well as the manufacturer's guidelines for using UCV systems. With the proper training and equipment, UVC disinfection systems can provide a comprehensive way to kill harmful pathogens in any workplace that requires it.