



Safe Operating Procedure

(Revised 11/22)

ULTRAVIOLET RADIATION

Background

This SOP provides information and recommendations for use and handling of devices that emit ultraviolet light (UV). Ultraviolet light is non-ionizing radiation that falls within the 100-400-nanometer wavelength region of the electromagnetic spectrum. Within this region UV rays are commonly broken down into the following three main sections:

| Region* | Hazard Potential | Wavelength (nm) |
|---------|------------------|-----------------|
| UVA | Lowest | 315-400 |
| UVB | Mid-High | 280-315 |
| UVC | Highest | 100-280 |

*The International Commission on Illumination

For most people, the main source of UV exposure is the sun. Exposure from the sun is typically limited to the UVA region, since the earth’s atmosphere protects us from the more harmful UVC and 97-99% of the UVB region. Limiting our exposure time and/or use of sunscreen lotions are usually an easy and effective method for controlling overexposure to UV radiation.

However, additional precautions should be taken when working in a laboratory. Common lab equipment can generate concentrated UV radiation in all three regions. Listed below are examples of common sources found at UNL that can generate varying levels of UV radiation.

Common Sources

UV Light Box/UV Transilluminator - Commonly used for visualizing nucleic acids, this “box-shaped” piece of equipment contains an ultraviolet lamp. The clear, glass face allows the light to illuminate the gel while potentially exposing the user. To reduce risk of injury, most models come equipped with a shield to filter excess light. For older models, there are various types of shields that can be attached that provide equal protection. For specifics contact the manufacturer or EHS.



UV Crosslinker - Used to attach nucleic acids to a surface or membrane following blotting procedures. Crosslinkers are equipped with door safety interlocks, which similar to a household microwave, prevent operation of the machine when the door is open. If the interlock system is not functioning correctly, refrain from using the device and contact the manufacturer.

Germicidal Lamps – Used for disinfecting the interior surfaces of a biosafety cabinet before and after use. Avoid working in or around the safety cabinet while germicidal lamp is on. If possible close sash for extra protection.

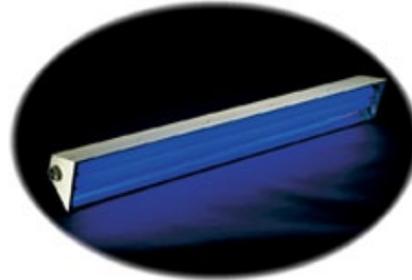
The CDC, NIH, National Sanitation Foundation, and the American Biological Safety Association all state that UV lamps are neither required nor recommended for use in a biological safety cabinet.

Their reasons are twofold: 1) UV intensity is significantly reduced by dust covered lamps and the interior of biosafety cabinet cluttered with equipment such as suction containers and 2) UV radiation at 18” in the front of the open sash can cause skin and eye burns in 15 minutes to exposed lab staff.



Portable or handheld Lamps

Some labs have handheld or portable UV lamps for use in various experiments. These types of UV radiations sources can be the most dangerous, because there is often little or no protection from the UV light emitted from these lamps. Use of personal protective equipment is essential when using these devices.



¹ <http://uvp.com/xxseries.html>

UV Radiation Generating Equipment

- | | |
|--------------------------------|----------------------------------------|
| Bio Safety Cabinet | Spectrometer |
| Crosslinker | Spectrophotometer |
| Finnigan Surveyor PDA Detector | UV Gel Dock |
| Fluorescence Detector | UV Microscopes |
| Fluorometer | UV Stratalinker |
| HPLC Machines | UV Transilluminator |
| Image Station | UV-VIS Detector |
| Laminar Flow Hoods | Waters 486 Tunable Absorbance Detector |
| Mineralight (Handheld) | UV Lasers |

Health Risks

Unfortunately, overexposure to UV radiation often times has no immediate warning signs. Symptoms of overexposure, including different stages of erythema (sunburn) or photokeratitis (welder’s flash) typically appear 4-24 hours after an exposure has occurred.

- **Skin** - UV radiation can initiate erythema within exposed skin. This “sunburn” consisting of “redness” and blistering varies in severity, and can occur from only a few seconds of exposure. Symptoms can also vary due to one’s genetic makeup. Pale to fair skin individuals are more susceptible to burns. In addition, various medications (i.e., birth control) can exaggerate

symptoms. Chronic exposure to UV radiation has been linked to premature skin aging, wrinkles, and skin cancer.

- **Eye** - UV radiation exposure can damage the cornea, the outer protection coating of the eye. Photokeratitis is a painful inflammation of the eye caused by UV radiation-induced lesions on the cornea. Symptoms include a “sand like” feeling in the eye that can last several days. Chronic exposures to short term UV radiation can lead to formation of cataracts.

Precautionary Measures

Engineering Controls:

- **Containment/Location** - Having equipment located in a separate room, alcove or low traffic area of a lab is ideal. To avoid exposure to other employees, avoid placing equipment in the direct vicinity of desk areas and or other equipment. Use of shields, curtains, UVR absorbing glass, or plastic is recommended.
- **Interlocks** - Some equipment comes with interlock devices. Interlock devices prevents operation of the equipment without use of safety equipment. Interlocks should not be tampered with. They should be replaced or repaired when defective.
- **Eliminating Reflection**- Many surfaces, especially those that are shiny, easily reflect UVR. To reduce the intensity of reflections, painting problematic surfaces with non-UVR-reflective material is effective.

Administrative Controls:

- **Training** - As in any activity within a lab setting, personnel should be trained and familiarized with the correct/safe way of using equipment. Users should read and adhere to all operating instructions and precautions of the equipment manufacturer.

At a minimum lab personnel should be familiar with the following when working with or around UV light:

- UV Light Producing Equipment
 - Warning Signs
 - Protective Equipment
 - Symptoms
- **Access**- Access should be limited to employees who are directly working with the equipment. In addition, limiting the distance and time an employee is working with or around UVR producing equipment significantly minimizes the risk for injury.

- **Warning Signs and Labels-** Many incidents of overexposure to UV radiation are the result of employees not being aware of the hazards associated with UV producing equipment. To avoid employees from being unknowingly overexposed, equipment should contain the following hazard label and/or one similar.



Personnel Protective Equipment (PPE):

Eyeglasses- Should be ANSI-Z87 rated and provide UV protection from side exposure via a side lens or “wrap around” lens. Normal eye protection and/or prescription glasses provide little to no protection! Contact the manufacturer for guidance on selecting Z87 ANSI eyewear with the appropriate UVE rating scale for your application. The rating of the eyeglasses will be printed on the lens.



Face Shield- UV-rated face shields should be worn in addition to eyeglasses or goggles.

Gloves- At a minimum nitrile or tightly woven fabric gloves are recommended, however glove should protect the employee not only from UV light but from the hazard of the activity being performed.

Lab Coat- Employees should cover exposed skin. Lab coats, along with proper lab attire should be worn.

UV Bulb and Lamp Disposal

Many of these devices have UV light bulbs that can be replaced. **DO NOT** dispose of UV bulbs in the regular trash. Disposal of these bulbs must be handled through EHS as the bulbs are considered hazardous and subject to certain regulatory requirements for disposal. Refer to the EHS SOP **Fluorescent and Other Non-Incandescent Lamps, Light Bulbs, And Ballasts** for further information about disposal.



Informational Resources

NSF International NSF/ANSI 49-2020 Class II (Laminar Flow) Biohazard Cabinetry

Ultraviolet Radiation. Health Physics Society.
<http://hps.org/hpspublications/articles/uv.html>.

Position Paper on the Use of UV Lights in Biological Safety Cabinets. Applied Biosafety. American Biological Safety Association. <https://www.liebertpub.com/doi/10.1177/153567600601100413>.