COLUMBIA UNIVERSITY
HEALTH SCIENCES DIVISION

ENVIRONMENTAL HEALTH & SAFETY

Working Safely with Ultraviolet Radiation

Policy and Procedures

Purpose: To provide information and guidelines for the safe use of Ultraviolet Radiation (UV) to protect the health of personnel using or potentially exposed during their work activities.
effects.

Types of UV Radiation:
UV radiation is divided into three distinct bands UV-A, UV-B and UV-C. Each has different penetration properties and potential for damage. The adverse health effects that may occur are erythema (sunburn), photokeratitis (a feeling of sand in the eyes), retinal burns, cataracts, melanoma and skin cancer.

Band	Wavelength	Primary Visual Hazard	Other Visual Hazards	Other Hazards
UV-A	315-400nm	cataracts of lens		skin cancer, retinal burns
UV-B	280-315nm	corneal injuries	cataracts of lens, photokeratitis	erythema, skin cancer
UV-C	100-280nm	corneal injuries	photokeratitis	erythema, skin cancer

The biological effects of UV radiation depend on the wavelengths concerned. Sources emitting radiation with wavelengths longer than 200nm are serious health hazards. Since UV radiation has such low penetrating power, the effects are confined mainly to the eyes and the skin.

The effects on skin are two types, acute and chronic. Acute effects appear within a few hours of exposure while chronic effects are long lasting, cumulative and may not appear for years. Acute effects of ultraviolet radiation are similar to sunburn; the redness of the skin called erythema. Chronic effects include accelerated skin aging and skin cancer.

The eye is very sensitive to UV where main effects are due to exposure to UV-B and UV-C, namely conjunctivitis and photokeratitis. In conjunctivitis the membranes lining the insides of the eyelids and covering the cornea become inflamed resulting in discomfort as if there was sand in the eyes. Photokeratitis manifests as an aversion to bright light. The severity of these conditions depends on the duration, intensity and wavelength of exposure. Symptoms may appear 6 to 12 hours after exposure and may subside after 24 to 36 hours with no permanent damage. Unlike the skin, the eyes do not develop a tolerance to repeated exposure to ultraviolet. The absorption of UV-A radiation in the lens of the eye is thought to produce progressive yellowing with time and may contribute to the formation of cataracts, causing partial or complete loss of transparency.

UV lamps often operate at pressures below or above atmospheric and may produce a risk of explosion particularly during lamp replacement or maintenance work.

Control Measures

Protection against exposure may be achieved by a combination of engineering, administrative control measures and personal protective equipment. Emphasis should always be placed on engineering and administrative control measures to minimize the need for personal protective equipment.

Engineering control measures include enclosures, screens or filters used to contain the UV radiation or devices such as interlocks to allow safe temporary access to a hazardous area. Reflective surfaces should be avoided and surfaces should be painted in a dark, dull color.

Administrative controls consist of warning signs, limitation of access and exposure time and the provision of information on the nature of the hazard and the precautions to be taken. The PI should decide what measures are necessary to limit access to the source and to make personnel aware of its presence. It may be necessary to install warning signs and/or lights and to limit exposure time.

After these steps have been taken it should be determined whether it is necessary to provide protection for the face, eyes or skin and what type of Personal Protective Equipment (PPE) is needed. PPE may consist of gloves, laboratory coat, UV protecting goggles and or face shield.

Exposure Limits

There is no Occupational Safety and Health Administration (OSHA) standard for exposure to ultraviolet light, but the National Institute for Occupational Safety and Health (NIOSH) recommends that the time of exposure to an intensity of 100 microwatts per square centimeter at wavelength 254 nanometers not exceed 1 minute. When averaged over an eight-hour work day, this value is 0.2 microwatts per square centimeter.

The American Conference of Governmental Industrial Hygienists (ACGIH) has issued Threshold Limit Values (TLVs) for occupational exposure to UV. These TLVs refer to ultraviolet radiation in the spectral region between 180 and 400 nm and represent conditions that nearly all workers may be repeatedly exposed without adverse health effects. The TLVs for occupational exposure to UV incident upon skin or eye are based on the irradiance and time of exposure. Broad band sources are weighted to determine the effective irradiance compared with the spectral effectiveness curve at 270 nm. Refer to current “Threshold Limit Values for Chemical Substances and Physical Agents” published by ACGIH for values.

Personnel must take adequate steps to shield themselves and in some cases limit the duration of exposure. Environmental Health and Safety (EH&S) office can provide assistance in measuring UV emissions and evaluating personal protective equipment.

It is also important to note that ozone is produced by sources emitting UV at wavelengths below 250 nm. Some UV devices may produce ozone in appreciable quantities and consideration should be given to monitoring exposure level.

Wavelength range: 400 - 315 nm

i Total irradiance on unprotected eyes and skin for periods of greater than 1000 seconds should not exceed 10 Wm^{-2}.

ii Total radiant exposure on unprotected eyes and skin for periods of less than 1000 seconds should not exceed 104 Jm^{-2}.

the University. Included in this list are recommendations for personal protective equipment and maintenance/monitoring.

instructions.